US006378277B1

(12) **United States Patent**
Inoue et al.

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(45) **Date of Patent: Apr. 30, 2002**

(54) **VERTICAL SEALING DEVICE FOR VERTICAL TYPE FORMING, FILLING AND CLOSING MACHINE FOR FLEXIBLE PACKAGES**

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(73) Assignee: **Tokyo Automatic Machinery Works, Ltd.**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/438,960**

(22) Filed: **Nov. 12, 1999**

(30) **Foreign Application Priority Data**

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Jun. 28, 1999 (JP) 11-182259

(51) **Int. Cl.**[7] **B65B 9/20**; B65B 57/04
(52) **U.S. Cl.** **53/614**; 53/73; 53/551
(58) **Field of Search** 53/64, 73, 551, 53/552, 502

(56) **References Cited**

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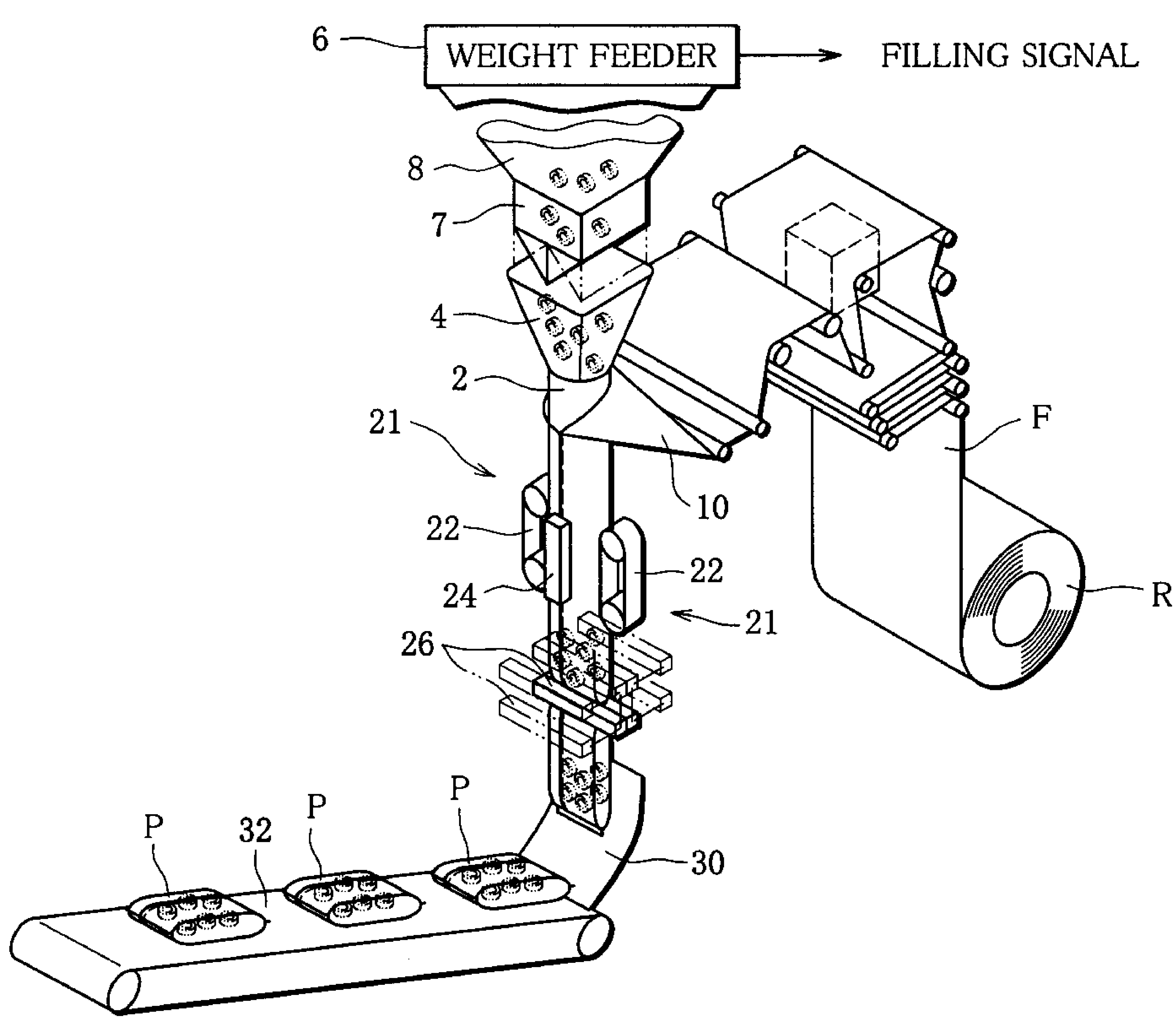
* cited by examiner

Primary Examiner—John Sipos
(74) *Attorney, Agent, or Firm*—Birch, Stewart, Kolasch & Birch, LLP

(57) **ABSTRACT**

A vertical sealing device for a packing machine includes a pair of feed units for feeding a cylindrical-formed packaging material and a center heat sealer for the heat-sealing of a vertical seam of the packaging material. When the operation of the machine is halted, the feed units feed the packaging material from a steady speed mode to a deceleration mode. During this deceleration mode, the operation of the center heat sealer is stopped. On the other hand, when the operation of the packing machine is restarted, the feed units feed the packaging material in an acceleration mode, and during this acceleration mode, the center heat sealer starts operating.

8 Claims, 28 Drawing Sheets



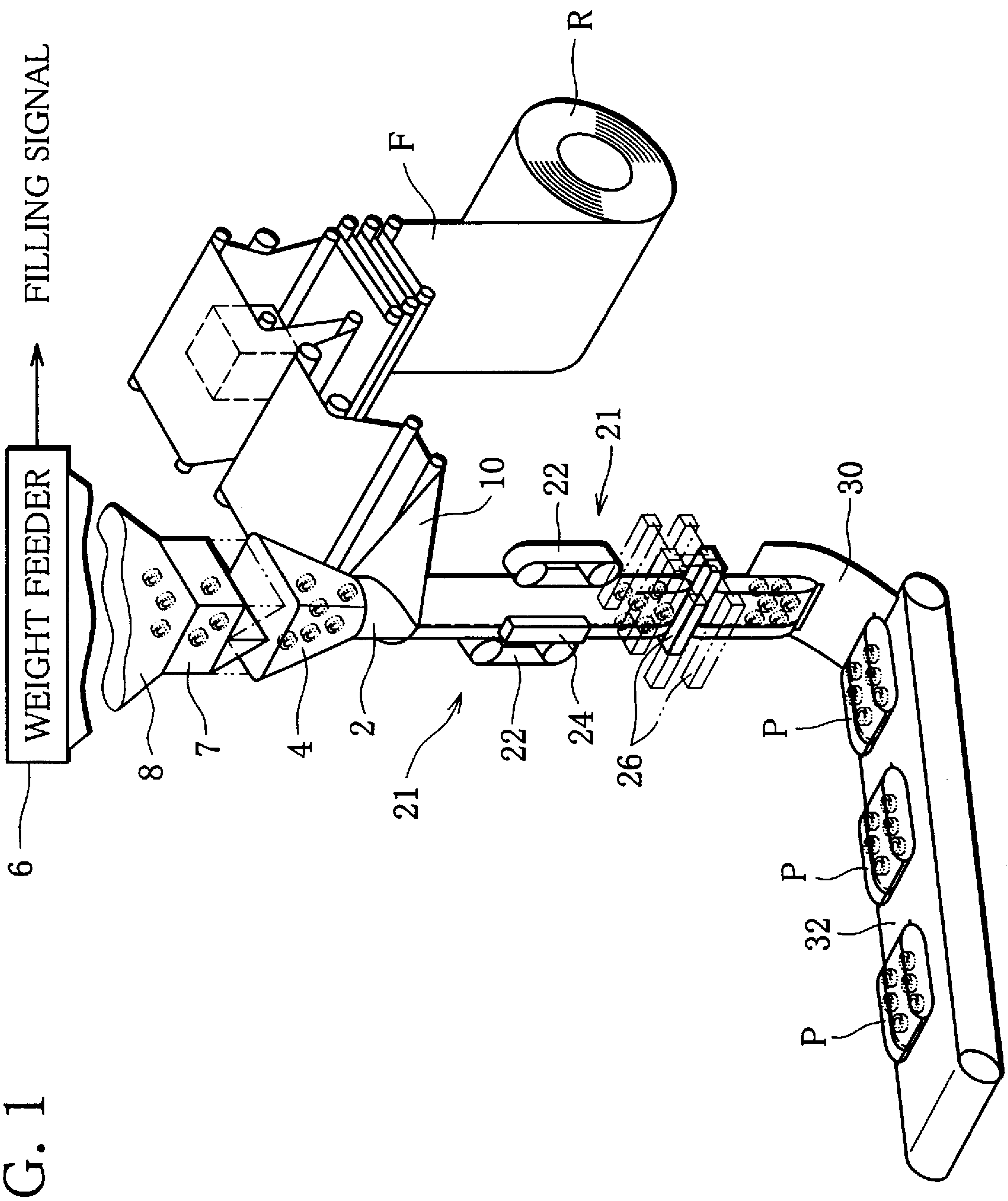

WEIGHT FEEDER
FILLING SIGNAL
6
8
7
4
2
10
F
R
21
22
24
26
22
21
30
P
P
32
P

FIG. 1

FIG. 2

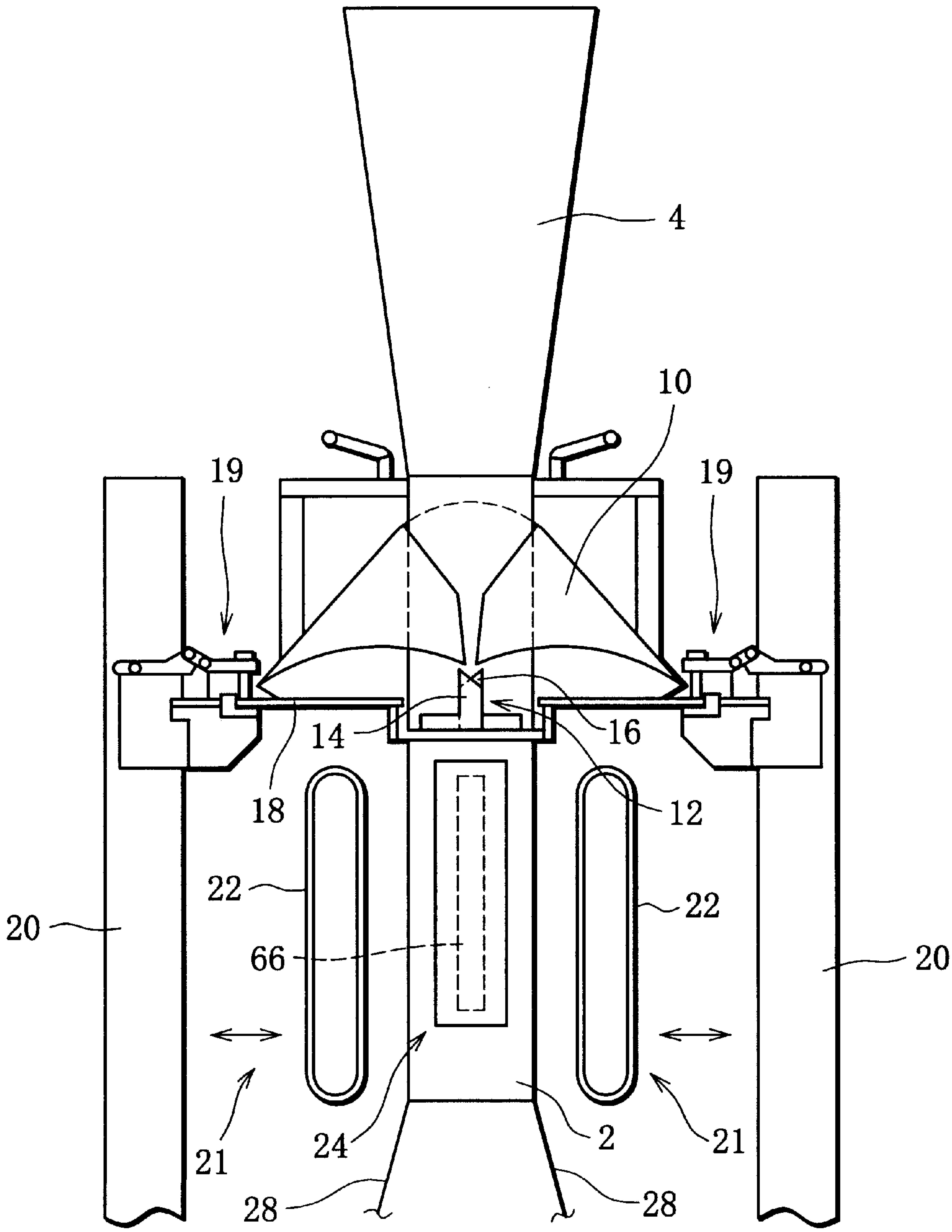


FIG. 3

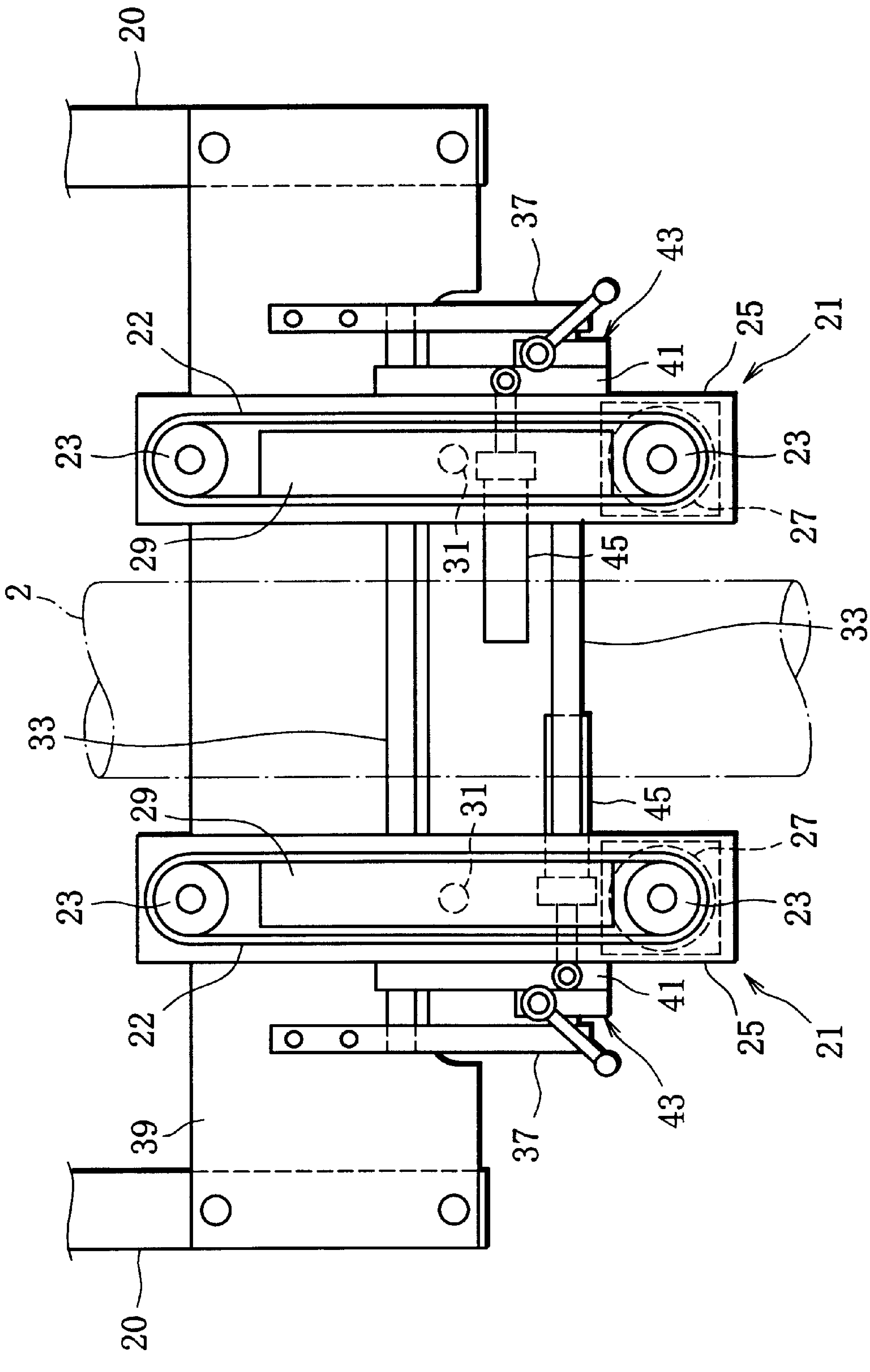

20
37
43
22
25
21
41
23
23
29
31
27
45
2
33
33
33
29
31
45
27
23
23
22
41
25
21
43
37
39
20

FIG. 4

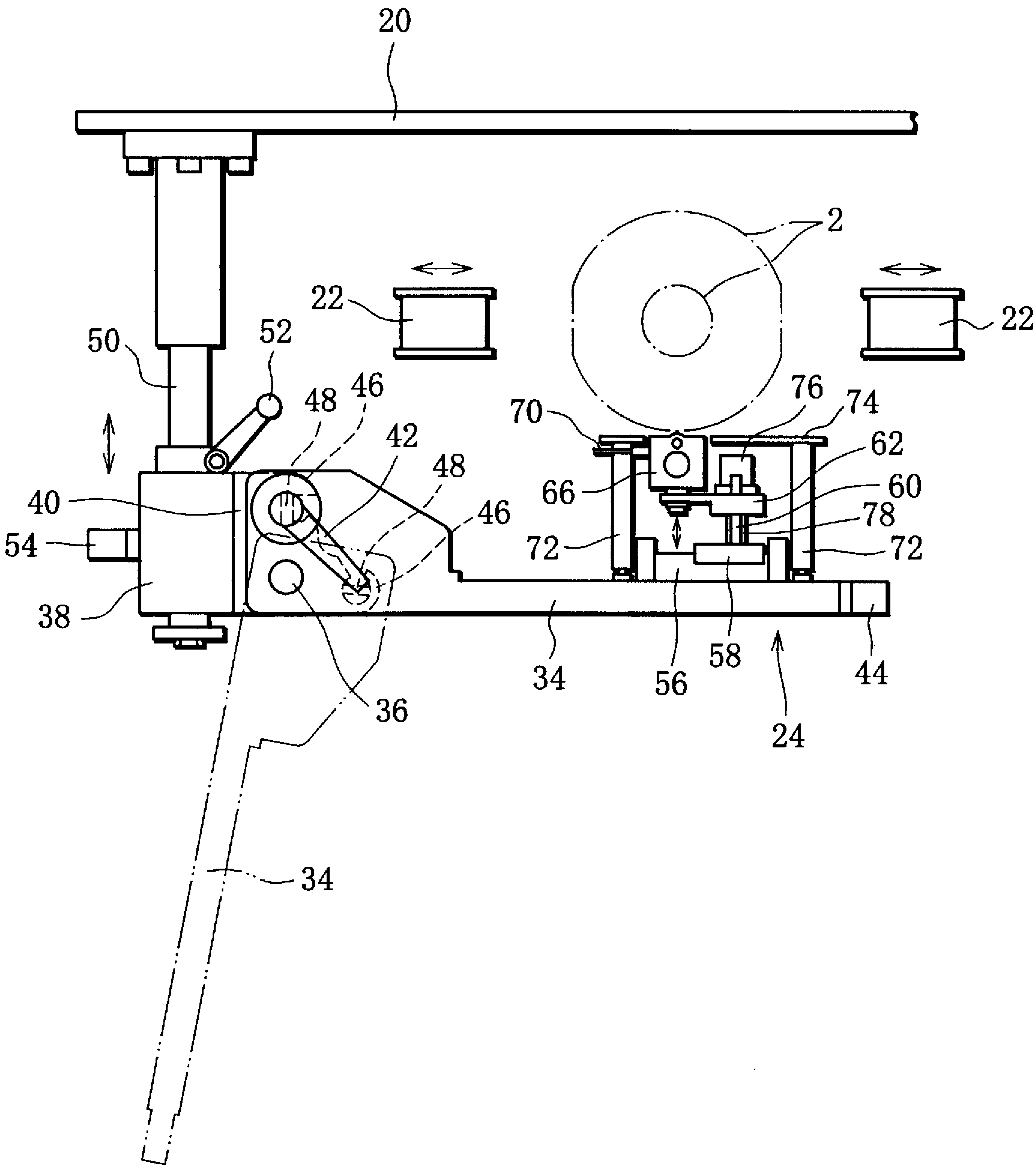

20
2
22
22
50
52
46
48
42
48
46
76
74
70
62
66
60
78
40
54
72
72
38
34
56
58
44
36
24
34

FIG. 5

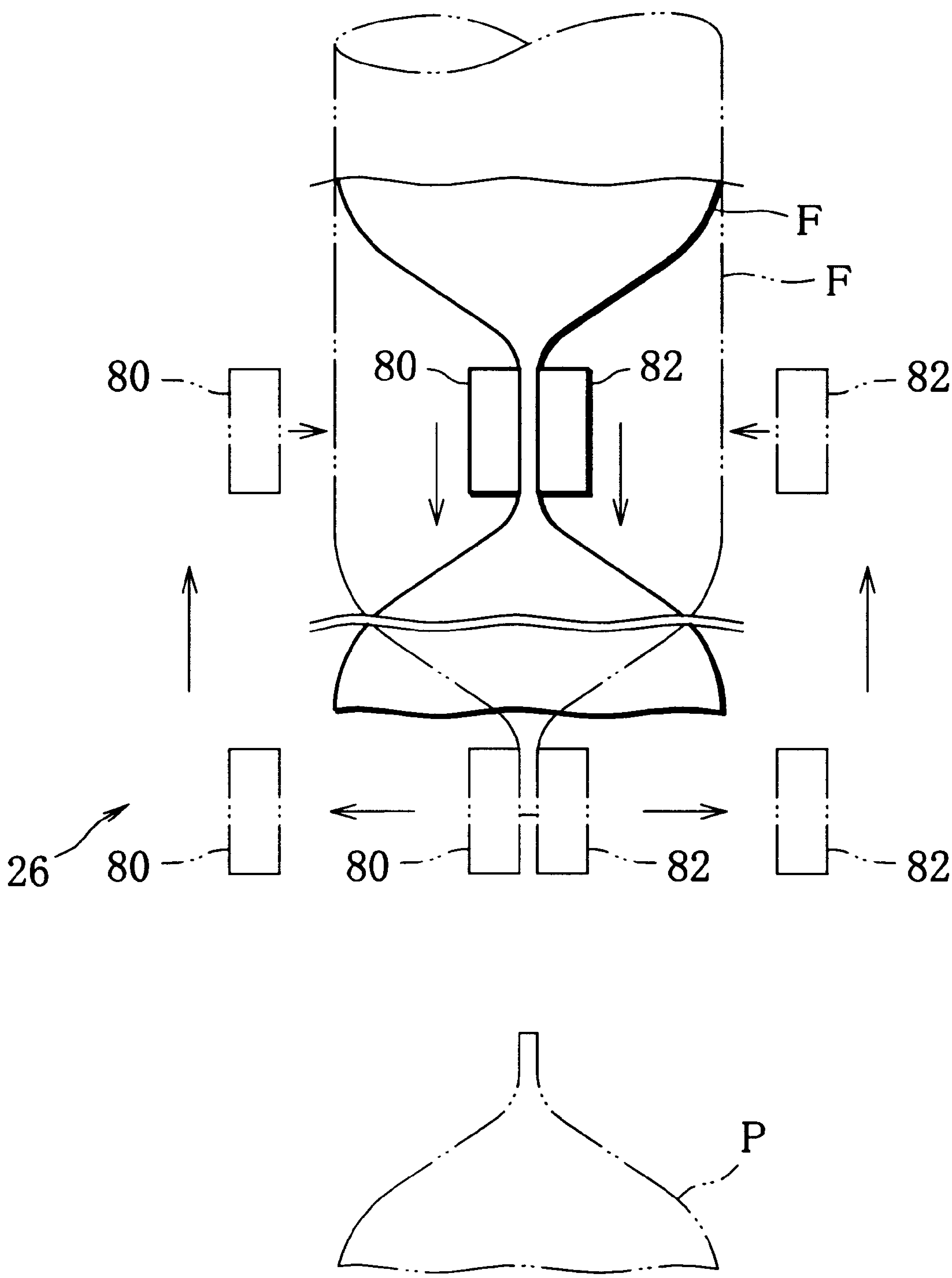


FIG. 6

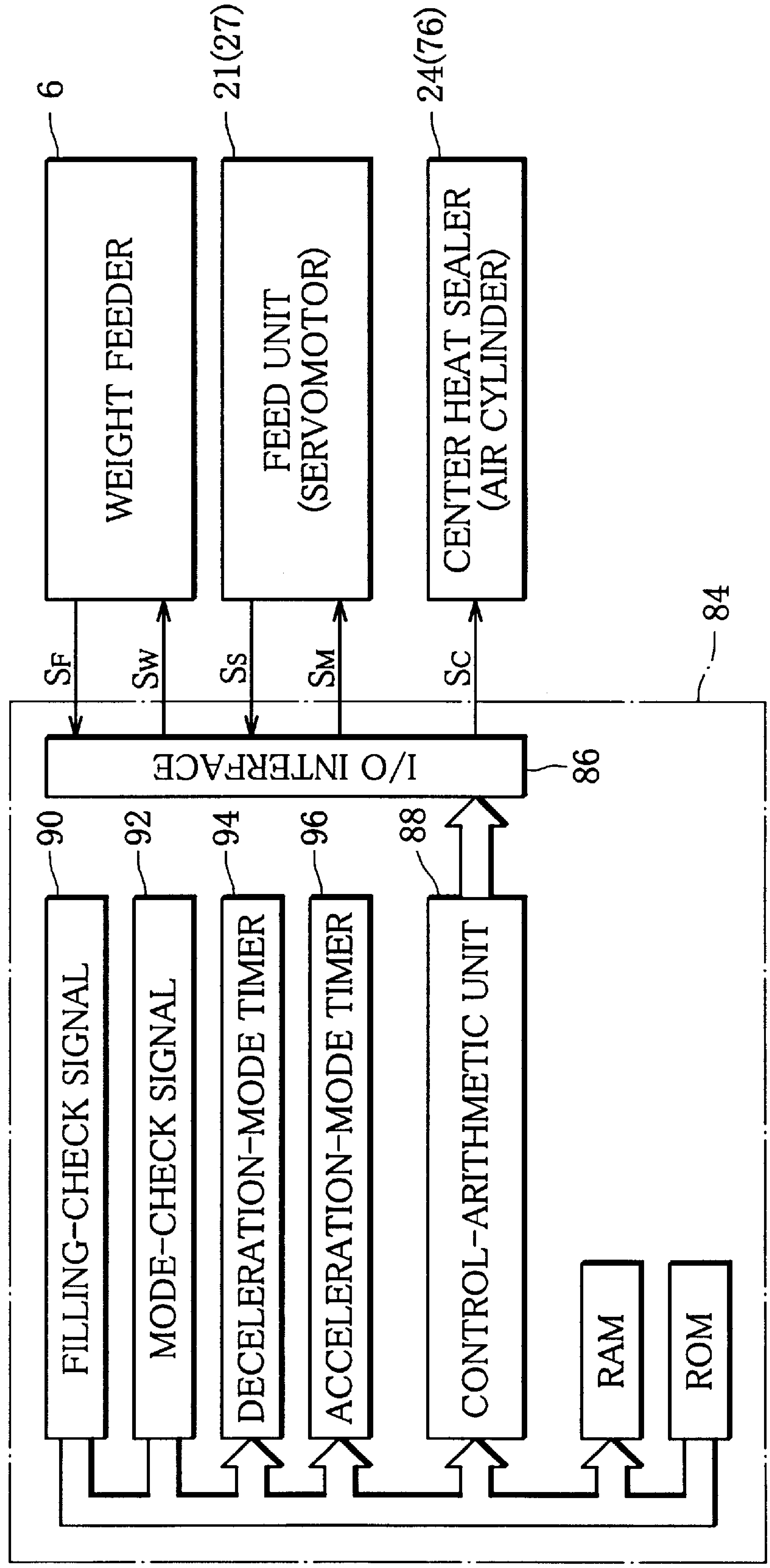

6
21(27)
24(76)
WEIGHT FEEDER
FEED UNIT (SERVOMOTOR)
CENTER HEAT SEALER (AIR CYLINDER)
84
SF
SW
SS
SM
SC
I/O INTERFACE
86
90
92
94
96
88
FILLING-CHECK SIGNAL
MODE-CHECK SIGNAL
DECELERATION-MODE TIMER
ACCELERATION-MODE TIMER
CONTROL-ARITHMETIC UNIT
RAM
ROM

FIG. 7

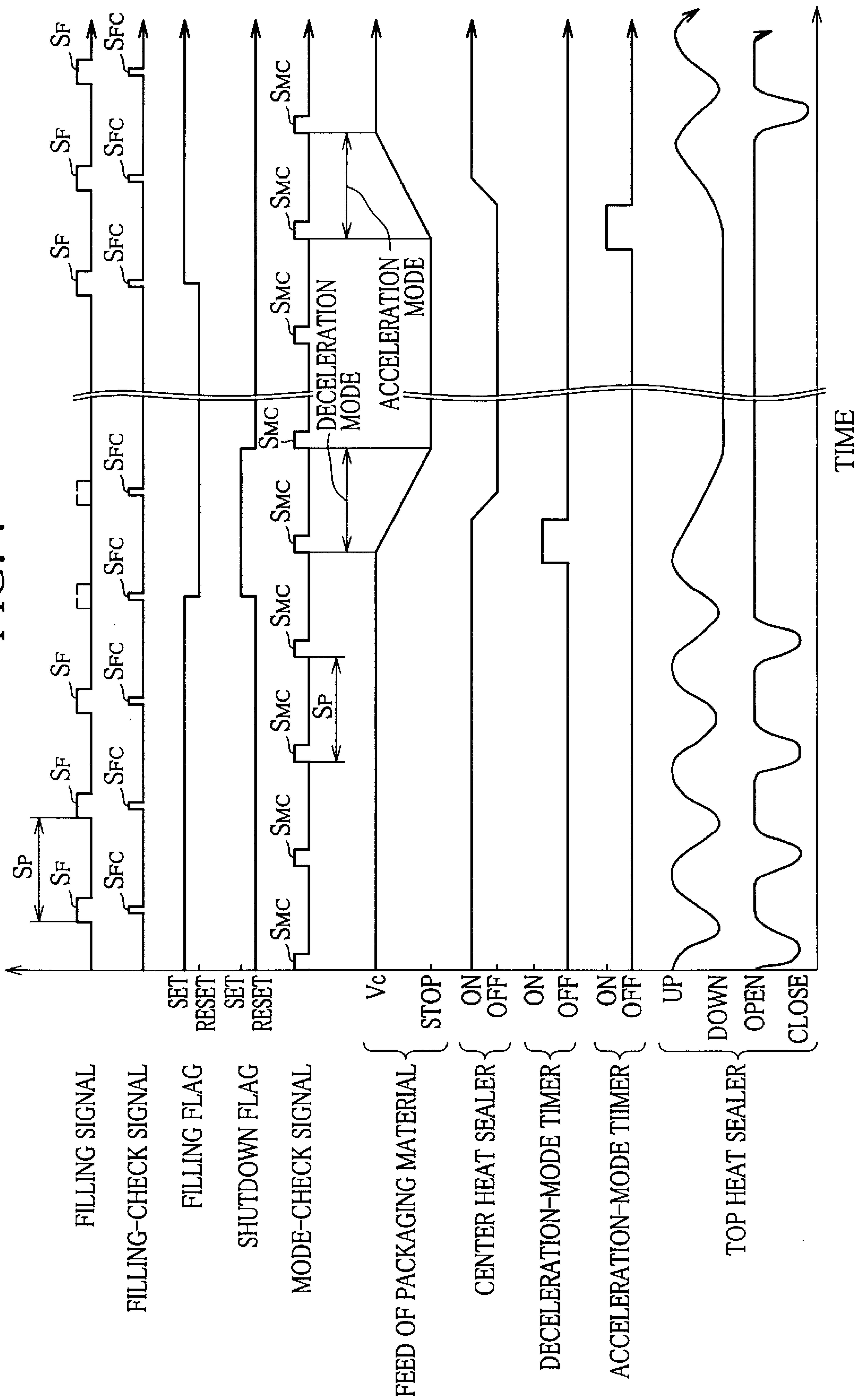

FILLING SIGNAL
FILLING-CHECK SIGNAL
FILLING FLAG
SHUTDOWN FLAG
MODE-CHECK SIGNAL
FEED OF PACKAGING MATERIAL
CENTER HEAT SEALER
DECELERATION-MODE TIMER
ACCELERATION-MODE TIIMER
TOP HEAT SEALER
SET
RESET
SET
RESET
Vc
STOP
ON
OFF
ON
OFF
ON
OFF
UP
DOWN
OPEN
CLOSE
SP
SF
SFC
SMC
SP
DECELERATION MODE
ACCELERATION MODE
TIME

FIG. 8

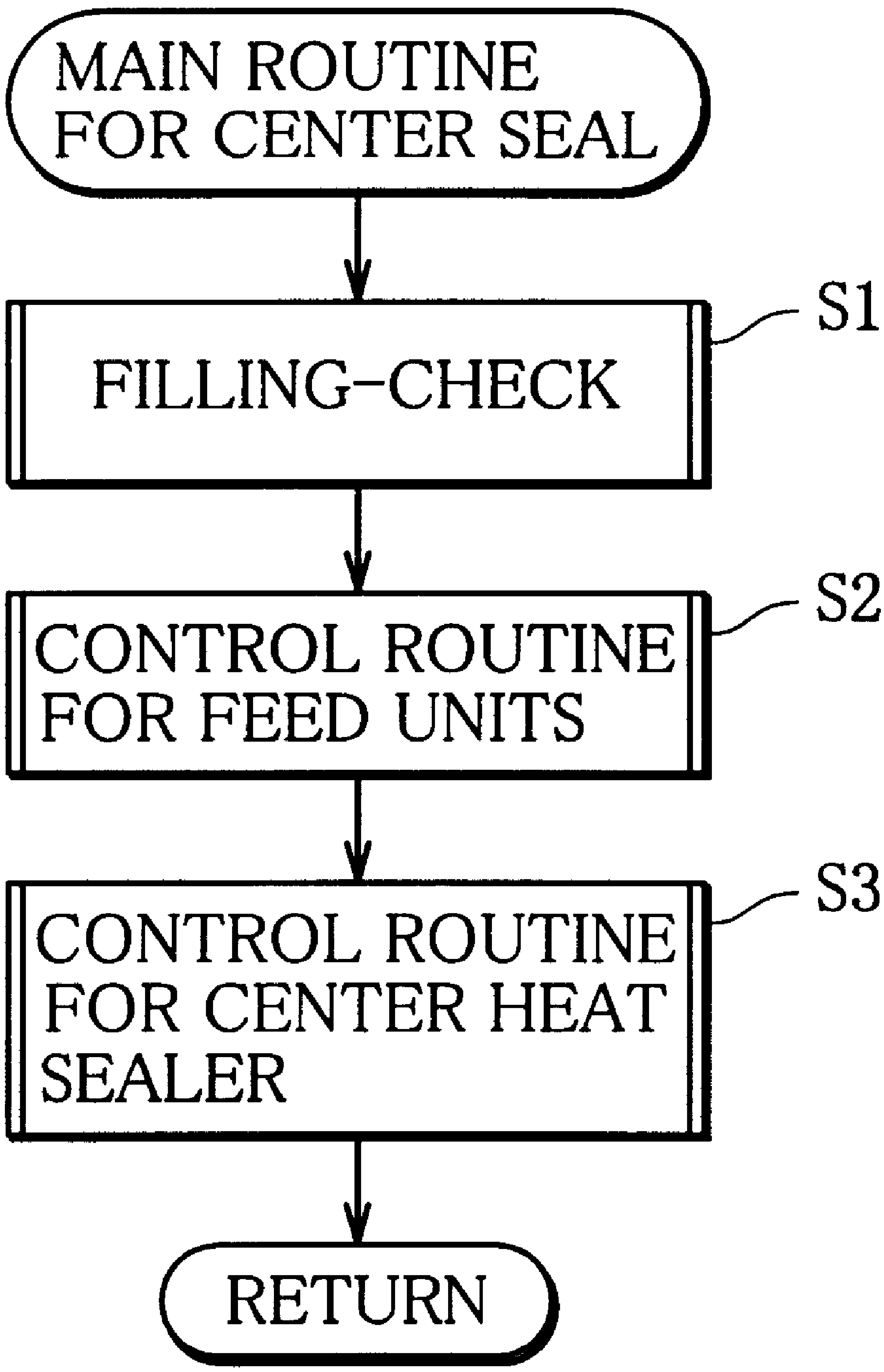

MAIN ROUTINE FOR CENTER SEAL
FILLING-CHECK
S1
CONTROL ROUTINE FOR FEED UNITS
S2
CONTROL ROUTINE FOR CENTER HEAT SEALER
S3
RETURN

FIG. 9

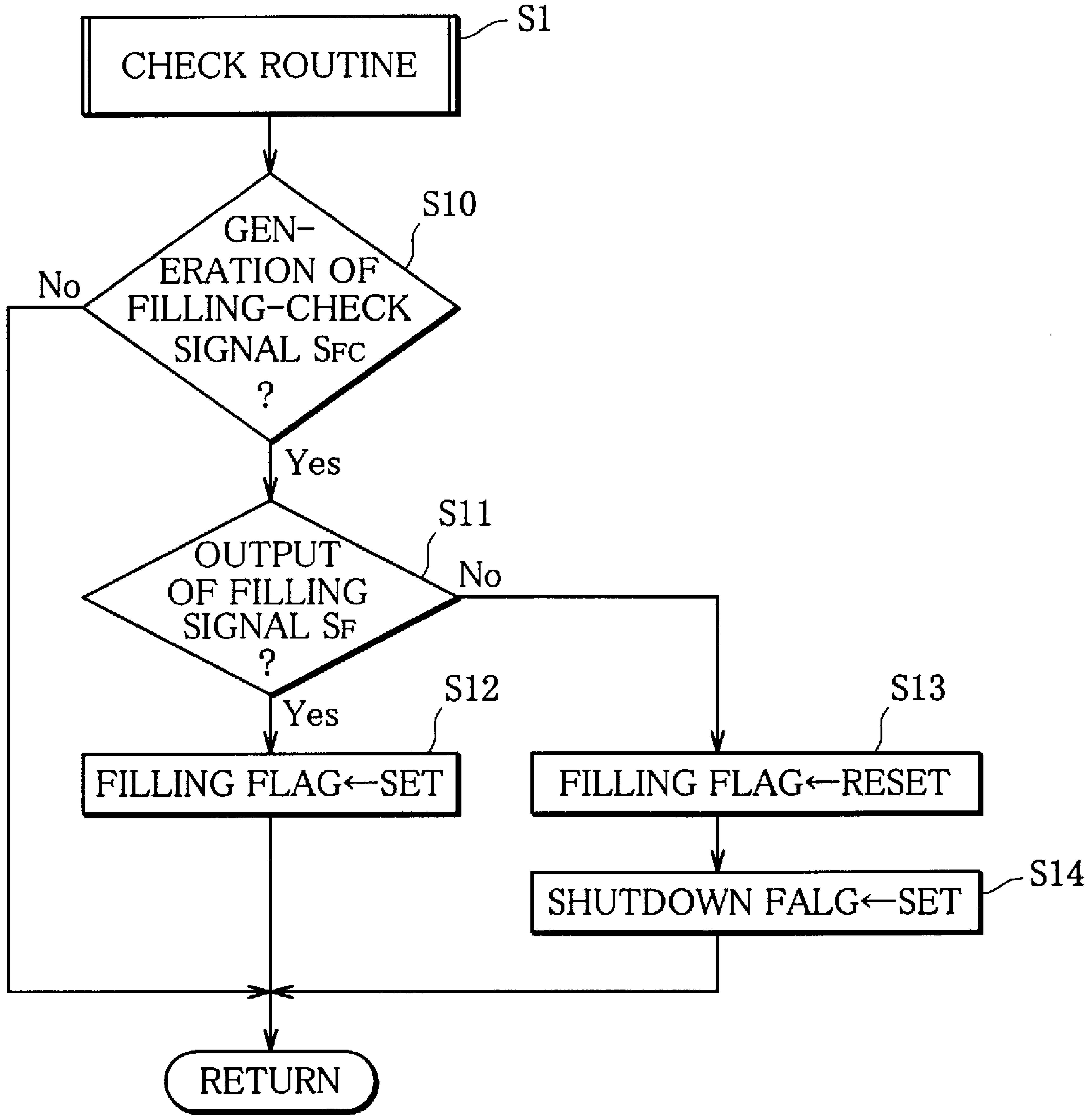
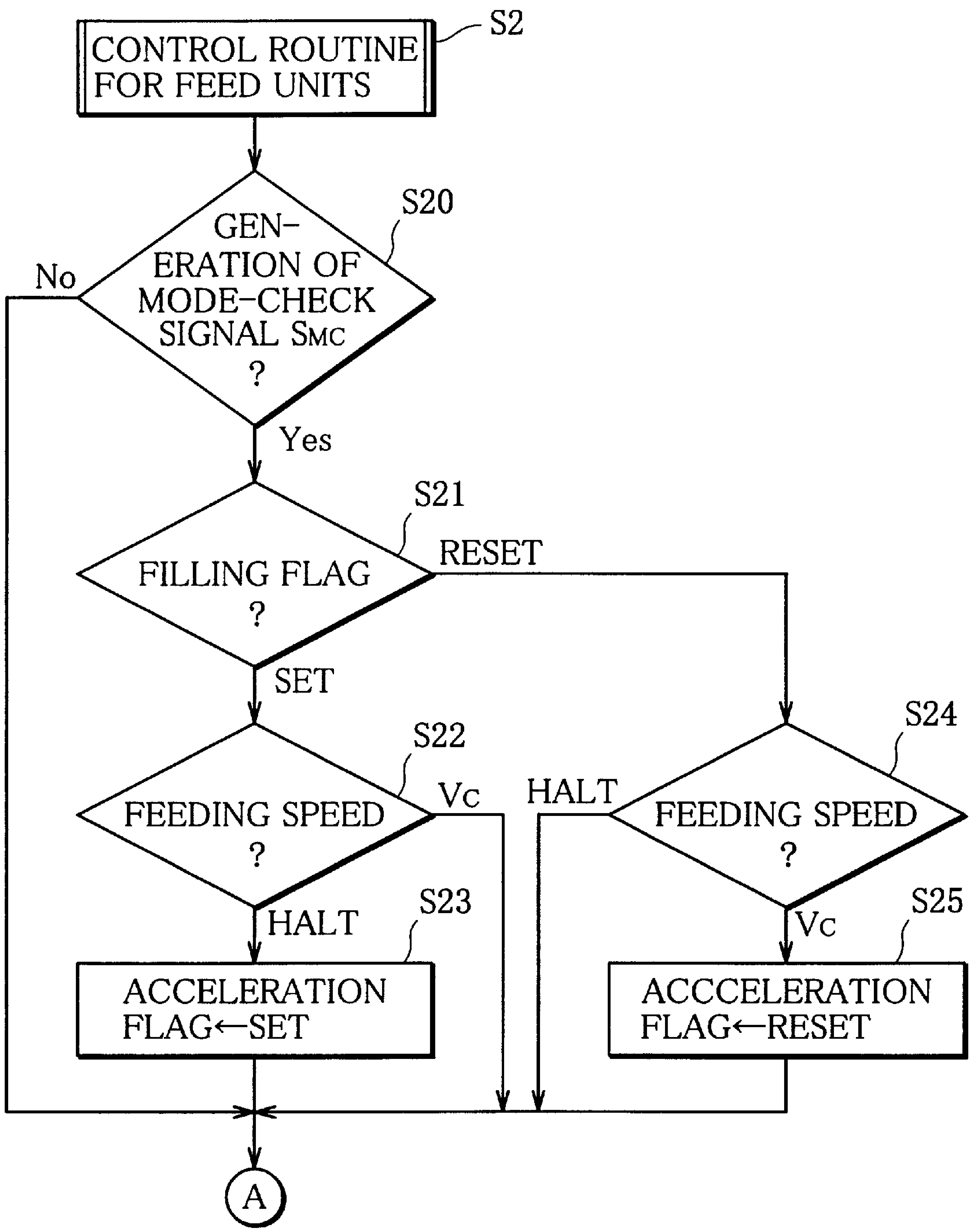

CHECK ROUTINE
S1
GEN-ERATION OF FILLING-CHECK SIGNAL SFC ?
S10
No
Yes
OUTPUT OF FILLING SIGNAL SF ?
S11
No
Yes
FILLING FLAG←SET
S12
FILLING FLAG←RESET
S13
SHUTDOWN FALG←SET
S14
RETURN

FIG. 10



CONTROL ROUTINE FOR FEED UNITS
S2
GEN-ERATION OF MODE-CHECK SIGNAL SMC ?
S20
No
Yes
FILLING FLAG ?
S21
RESET
SET
FEEDING SPEED ?
S22
Vc
HALT
S23
ACCELERATION FLAG←SET
FEEDING SPEED ?
S24
HALT
Vc
S25
ACCCELERATION FLAG←RESET
A

FIG. 11

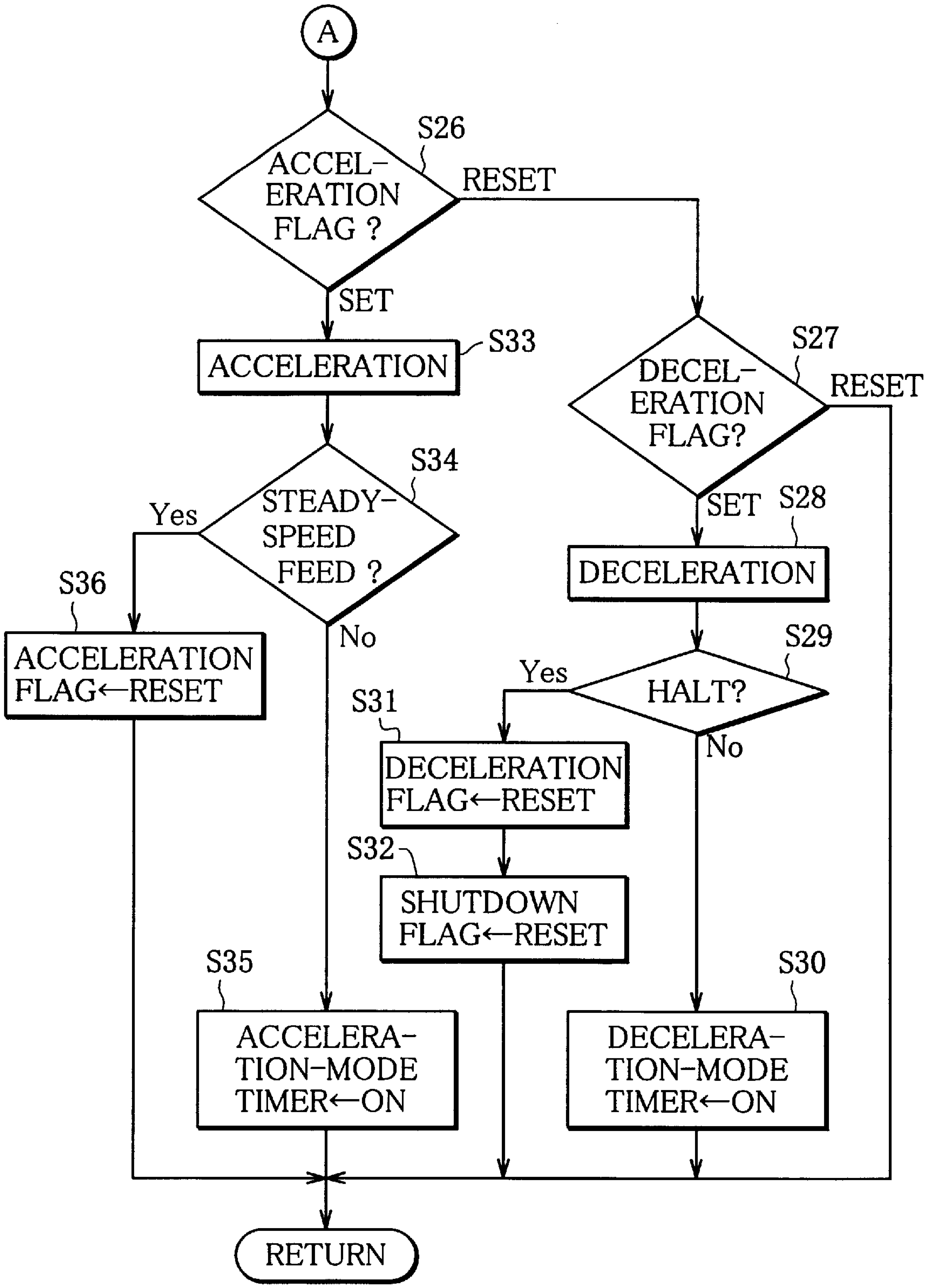
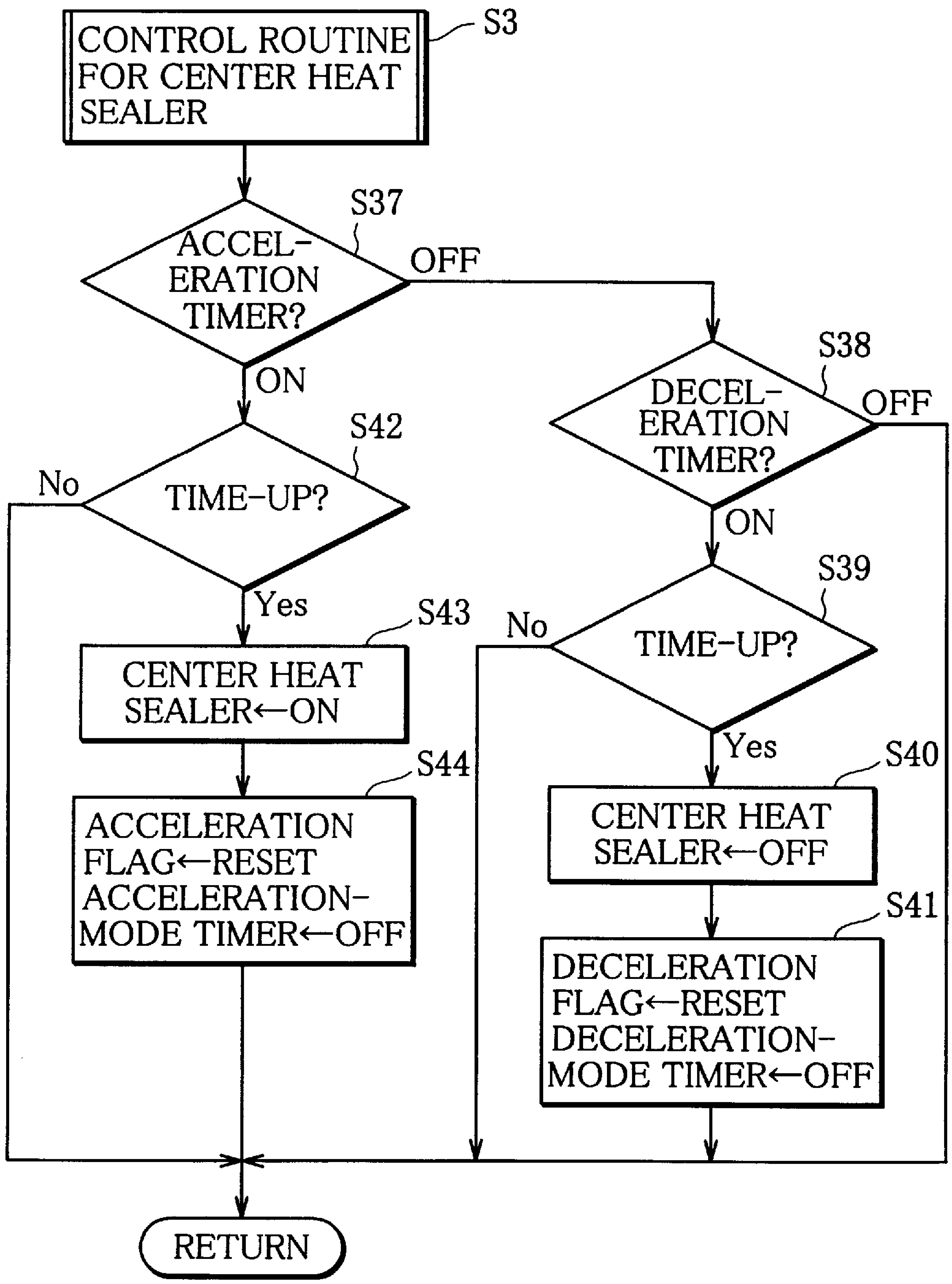
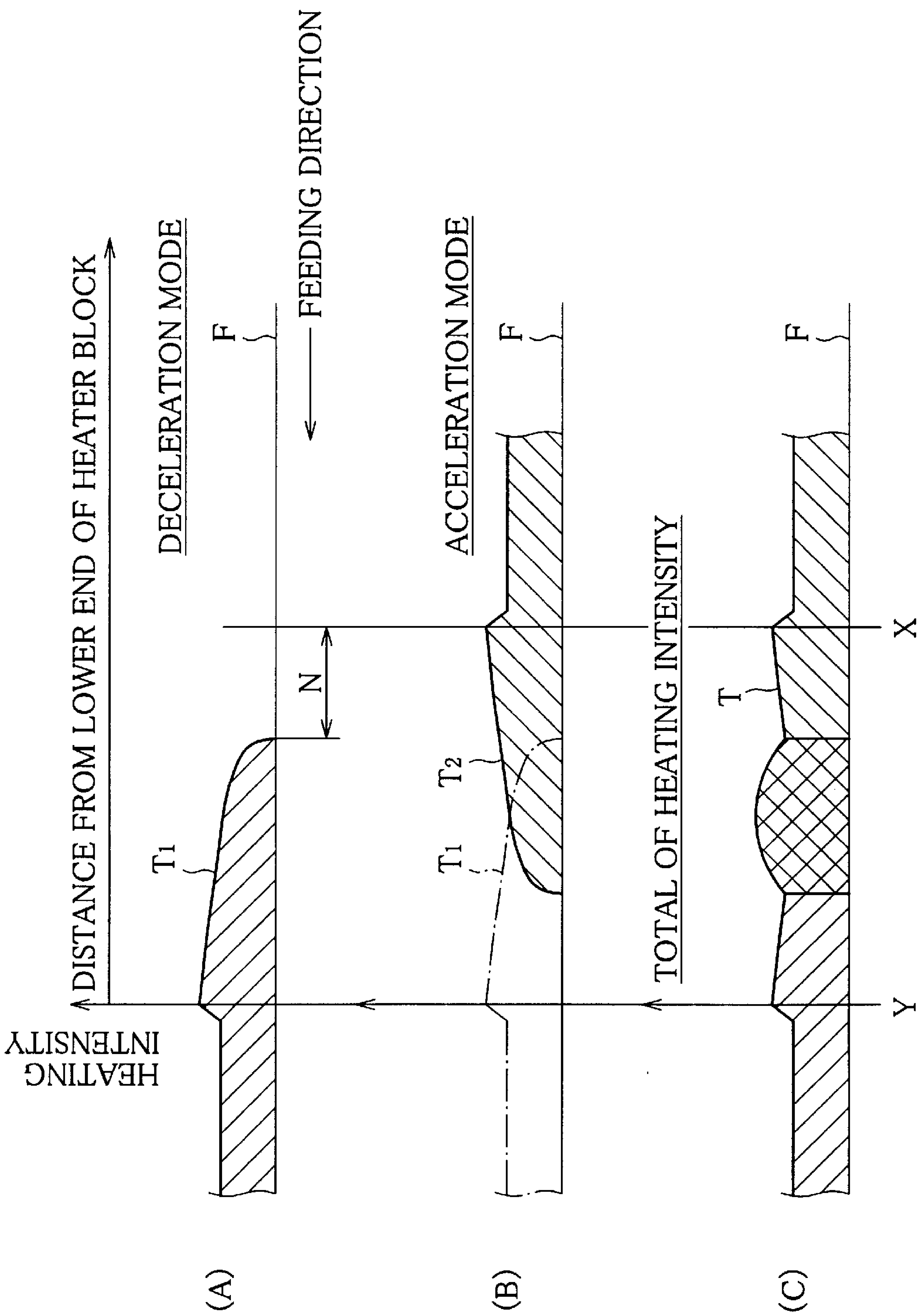

A
S26
ACCEL-
ERATION
FLAG ?
RESET
SET
ACCELERATION
S33
S27
DECEL-
ERATION
FLAG?
RESET
S34
STEADY-
SPEED
FEED ?
Yes
No
S36
ACCELERATION
FLAG←RESET
SET
S28
DECELERATION
S29
HALT?
Yes
No
S31
DECELERATION
FLAG←RESET
S32
SHUTDOWN
FLAG←RESET
S35
ACCELERA-
TION-MODE
TIMER←ON
S30
DECELERA-
TION-MODE
TIMER←ON
RETURN

FIG. 12



CONTROL ROUTINE FOR CENTER HEAT SEALER
S3
ACCEL-ERATION TIMER?
S37
OFF
ON
DECEL-ERATION TIMER?
S38
OFF
ON
TIME-UP?
S42
No
Yes
CENTER HEAT SEALER←ON
S43
ACCELERATION FLAG←RESET ACCELERATION-MODE TIMER←OFF
S44
TIME-UP?
S39
No
Yes
CENTER HEAT SEALER←OFF
S40
DECELERATION FLAG←RESET DECELERATION-MODE TIMER←OFF
S41
RETURN

FIG. 13



DISTANCE FROM LOWER END OF HEATER BLOCK
HEATING INTENSITY
DECELERATION MODE
FEEDING DIRECTION
F
N
T1
ACCELERATION MODE
T2
T1
TOTAL OF HEATING INTENSITY
T
X
Y
(A)
(B)
(C)

FIG. 14

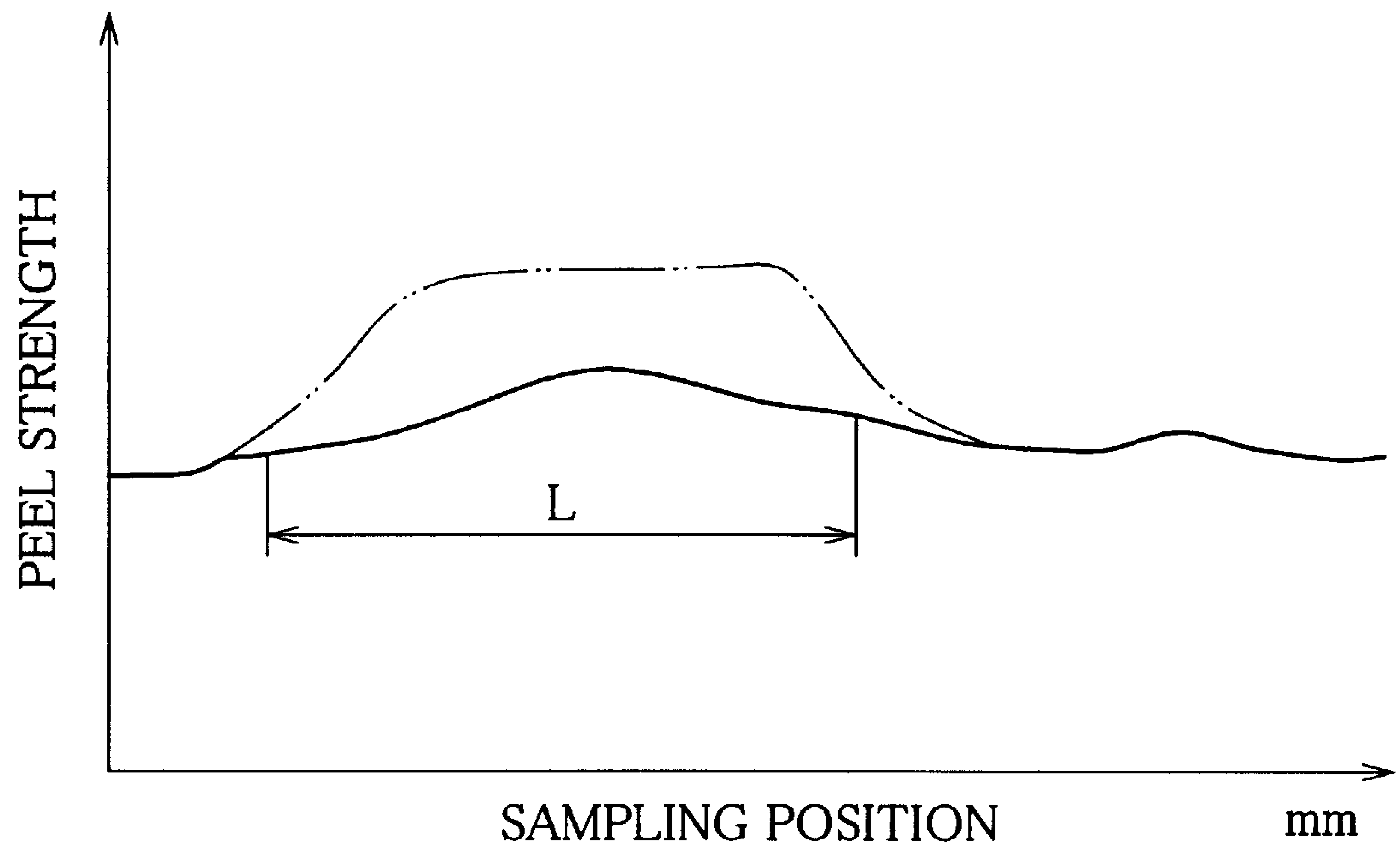

PEEL STRENGTH
L
SAMPLING POSITION
mm

FIG. 15

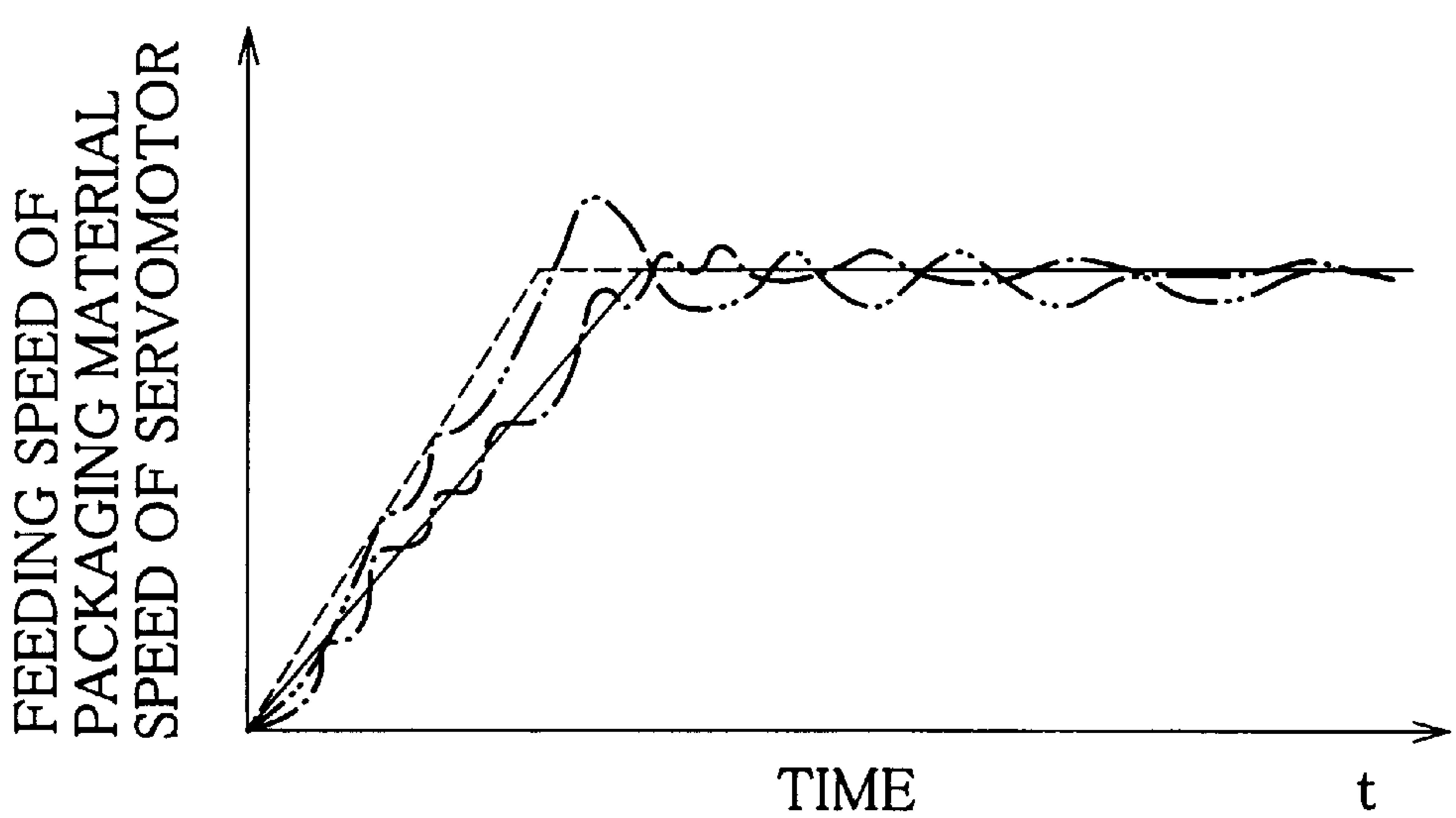
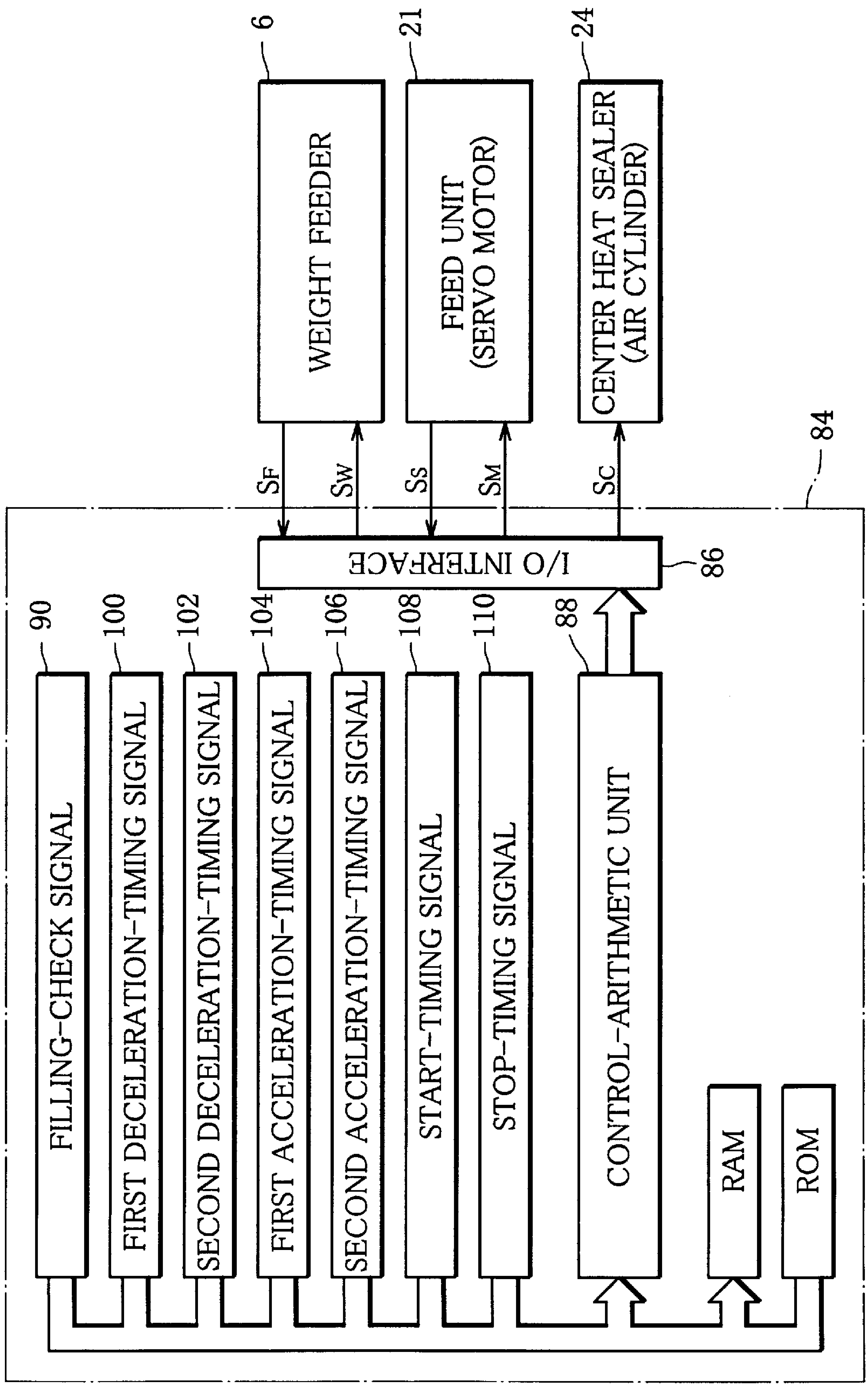

FEEDING SPEED OF
PACKAGING MATERIAL
SPEED OF SERVOMOTOR
TIME
t

FIG. 16



6
WEIGHT FEEDER
21
FEED UNIT
(SERVO MOTOR)
24
CENTER HEAT SEALER
(AIR CYLINDER)
SF
SW
SS
SM
SC
84
I/O INTERFACE
86
90
FILLING-CHECK SIGNAL
100
FIRST DECELERATION-TIMING SIGNAL
102
SECOND DECELERATION-TIMING SIGNAL
104
FIRST ACCELERATION-TIMING SIGNAL
106
SECOND ACCELERATION-TIMING SIGNAL
108
START-TIMING SIGNAL
110
STOP-TIMING SIGNAL
88
CONTROL-ARITHMETIC UNIT
RAM
ROM

FIG. 17

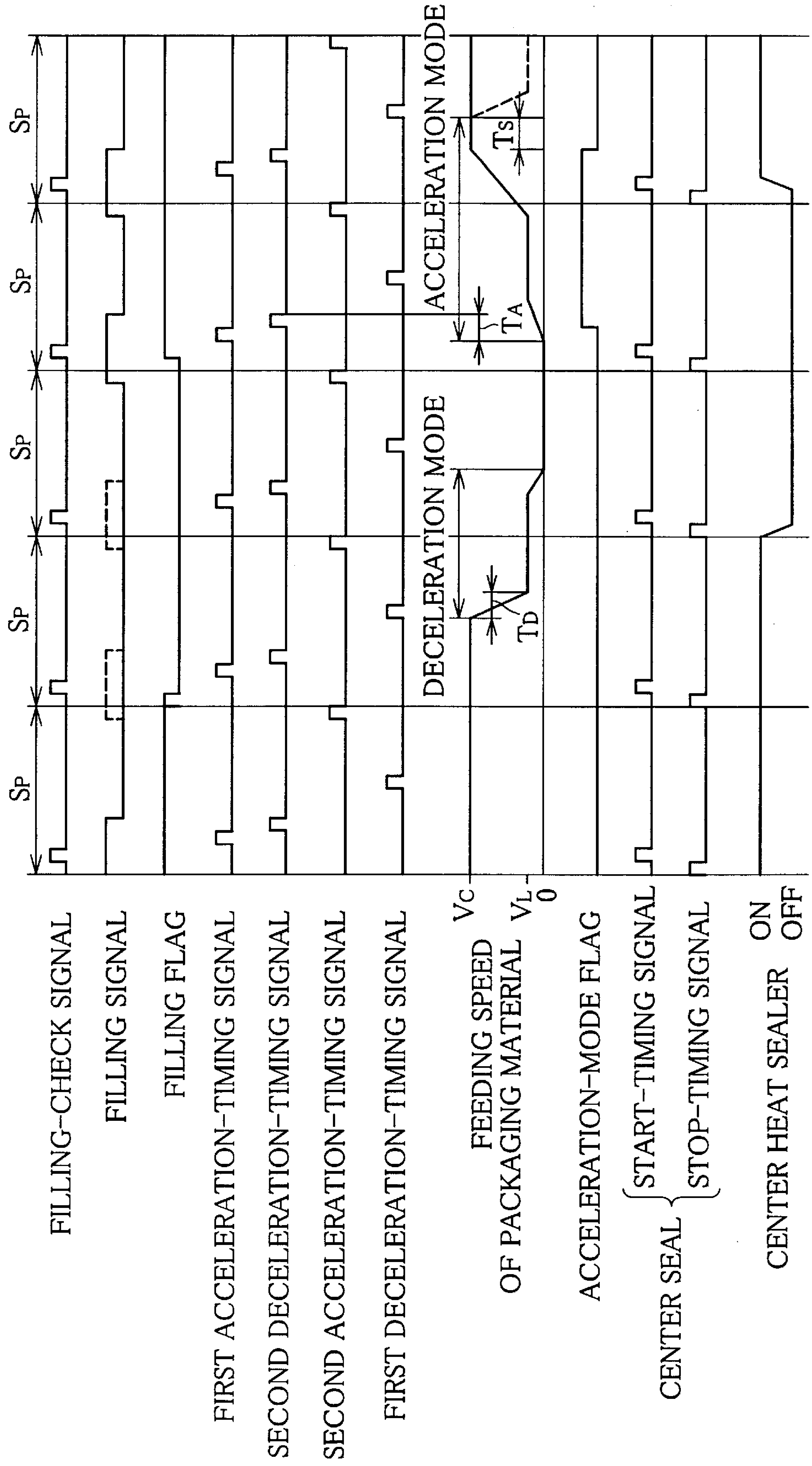

SP
ACCELERATION MODE
DECELERATION MODE
TS
TA
TD
VC
VL
0
ON
OFF
FILLING-CHECK SIGNAL
FILLING SIGNAL
FILLING FLAG
FIRST ACCELERATION-TIMING SIGNAL
SECOND DECELERATION-TIMING SIGNAL
SECOND ACCELERATION-TIMING SIGNAL
FIRST DECELERATION-TIMING SIGNAL
FEEDING SPEED OF PACKAGING MATERIAL
ACCELERATION-MODE FLAG
CENTER SEAL
START-TIMING SIGNAL
STOP-TIMING SIGNAL
CENTER HEAT SEALER

FIG. 18

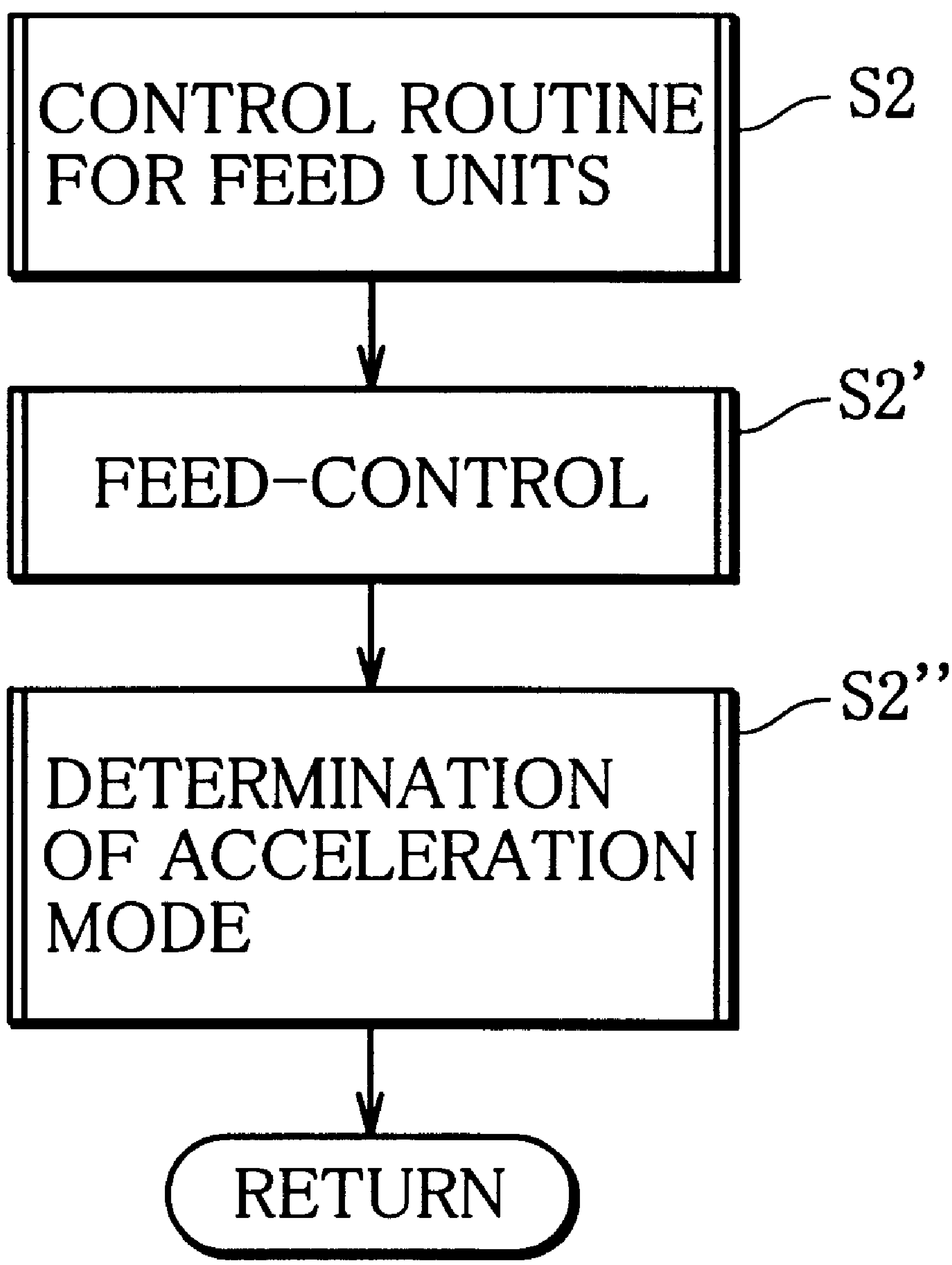

CONTROL ROUTINE FOR FEED UNITS
S2
FEED-CONTROL
S2'
DETERMINATION OF ACCELERATION MODE
S2''
RETURN

FIG. 19

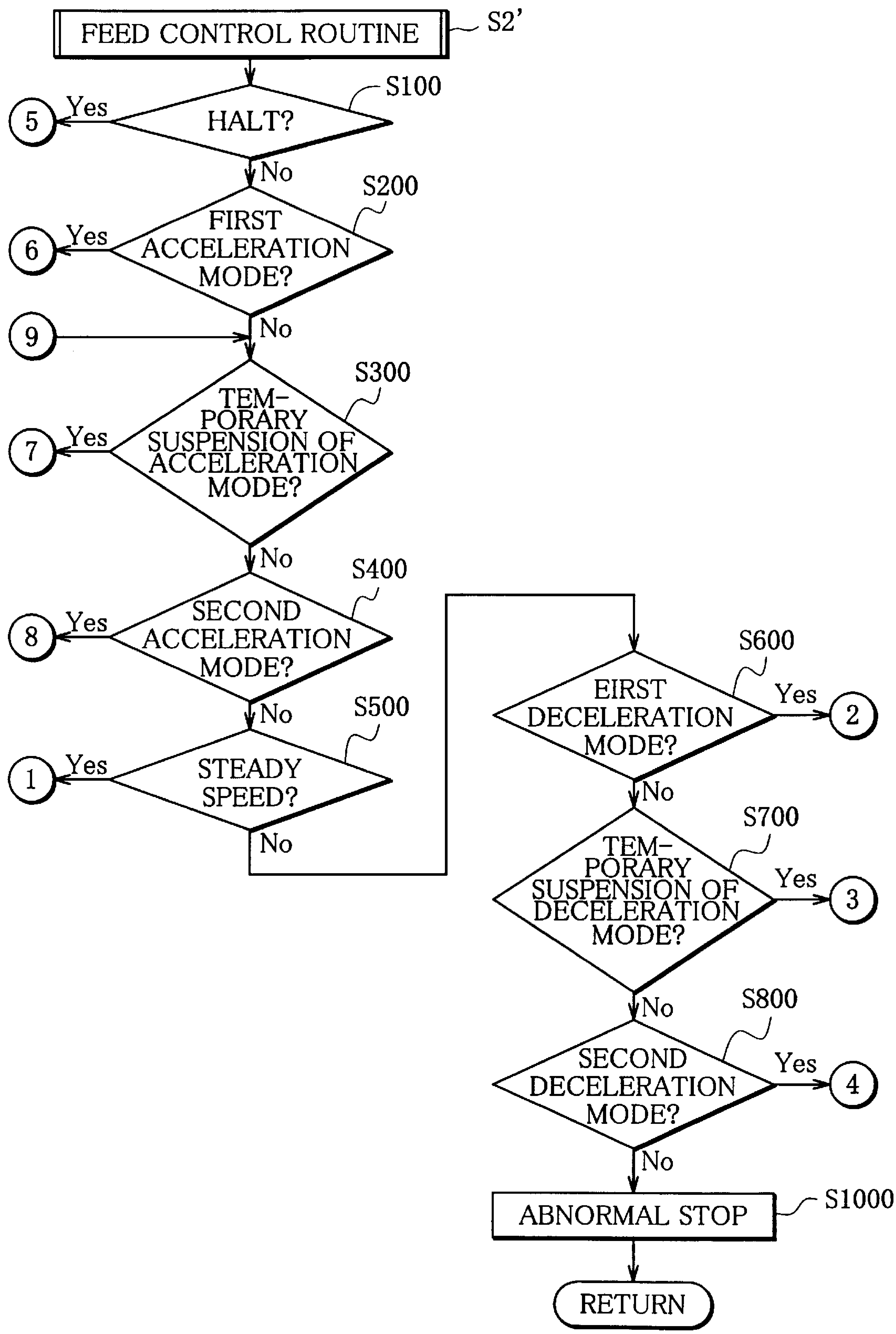

FEED CONTROL ROUTINE
S2'
HALT?
S100
Yes
No
5
FIRST ACCELERATION MODE?
S200
6
9
TEM-PORARY SUSPENSION OF ACCELERATION MODE?
S300
7
SECOND ACCELERATION MODE?
S400
8
STEADY SPEED?
S500
1
EIRST DECELERATION MODE?
S600
2
TEM-PORARY SUSPENSION OF DECELERATION MODE?
S700
3
SECOND DECELERATION MODE?
S800
4
ABNORMAL STOP
S1000
RETURN

FIG. 20

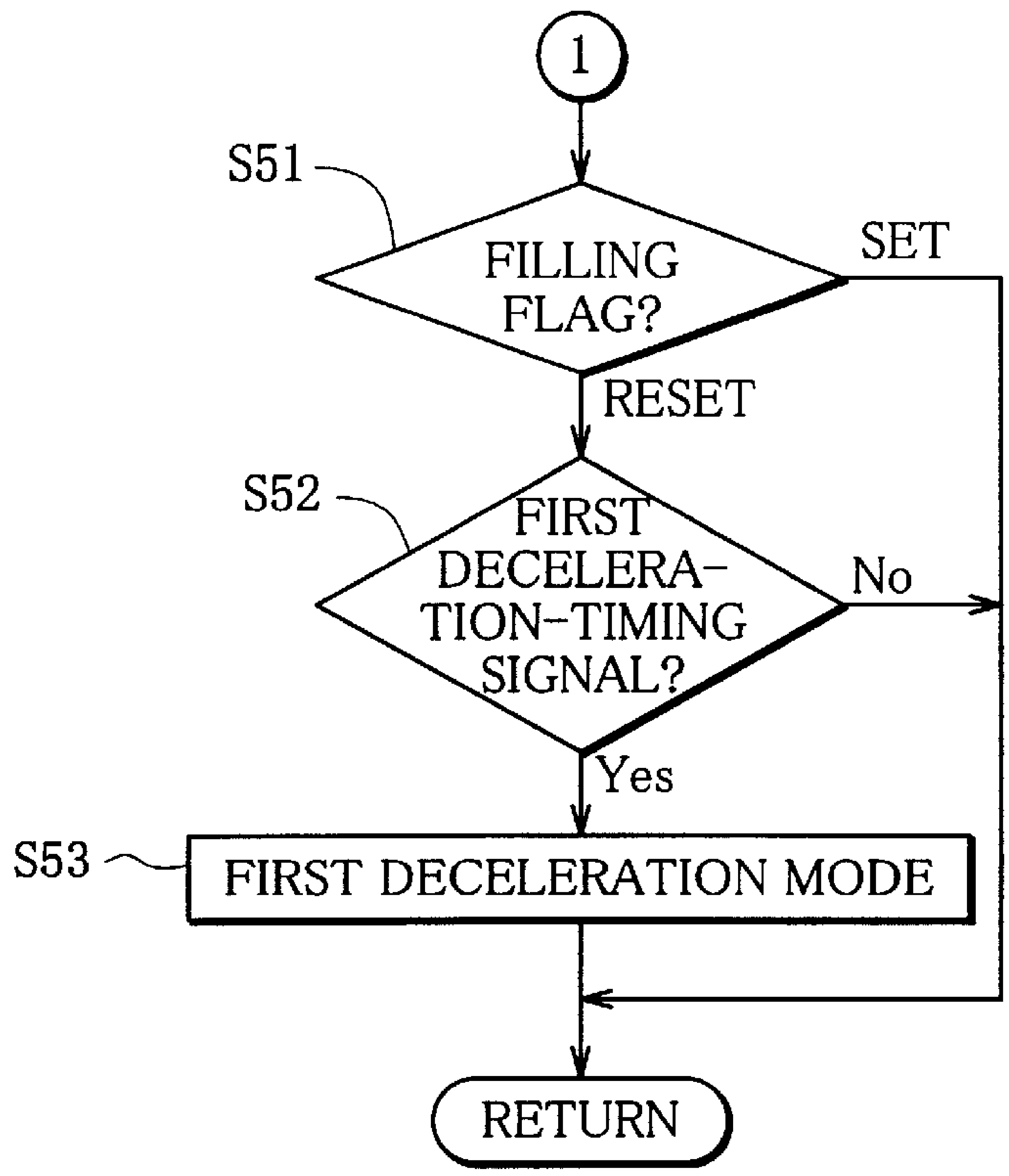

1
S51
FILLING FLAG?
SET
RESET
S52
FIRST DECELERA-TION-TIMING SIGNAL?
No
Yes
S53
FIRST DECELERATION MODE
RETURN

FIG. 21

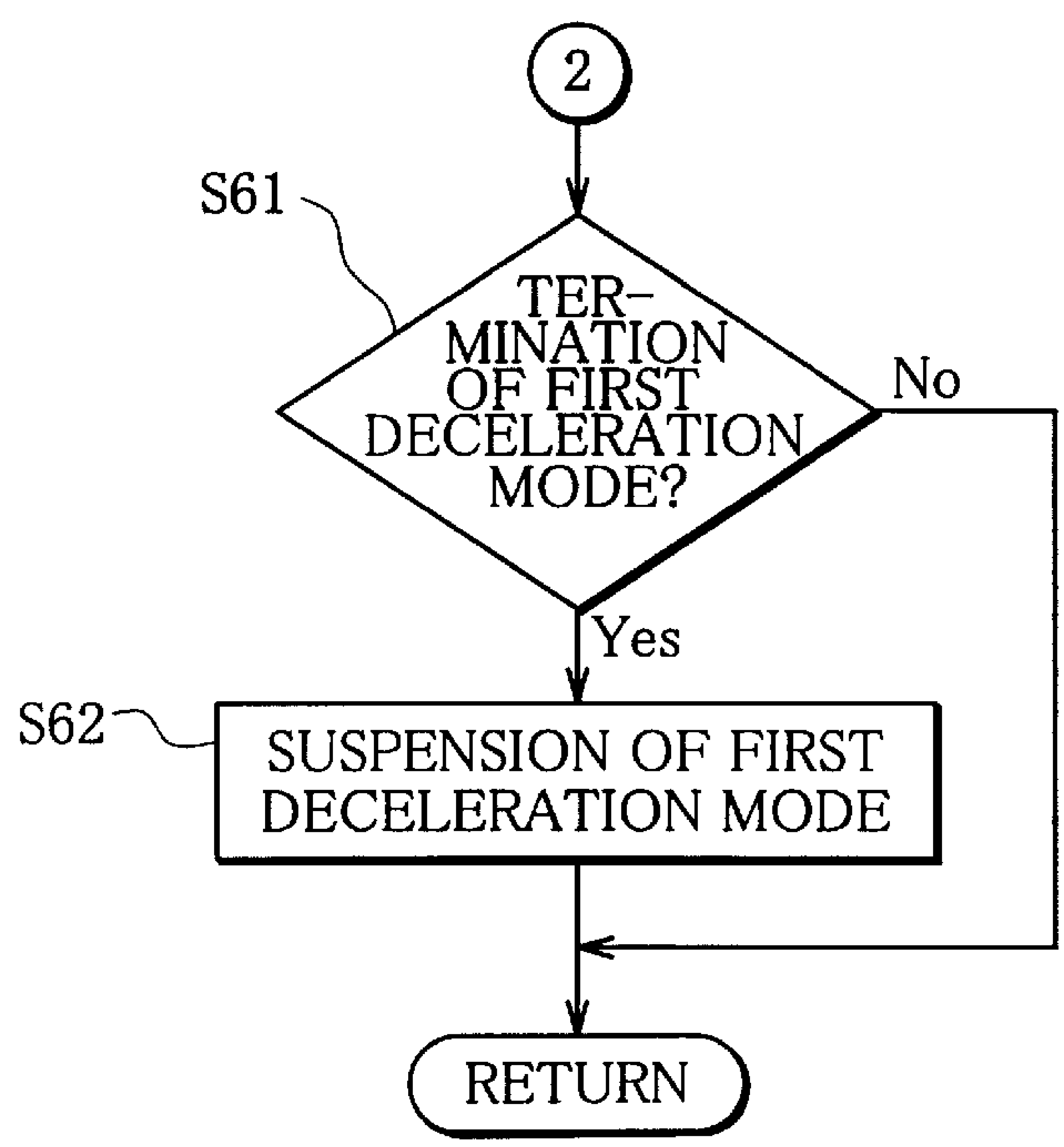

2
S61
TER-MINATION OF FIRST DECELERATION MODE?
No
Yes
S62
SUSPENSION OF FIRST DECELERATION MODE
RETURN

FIG. 22

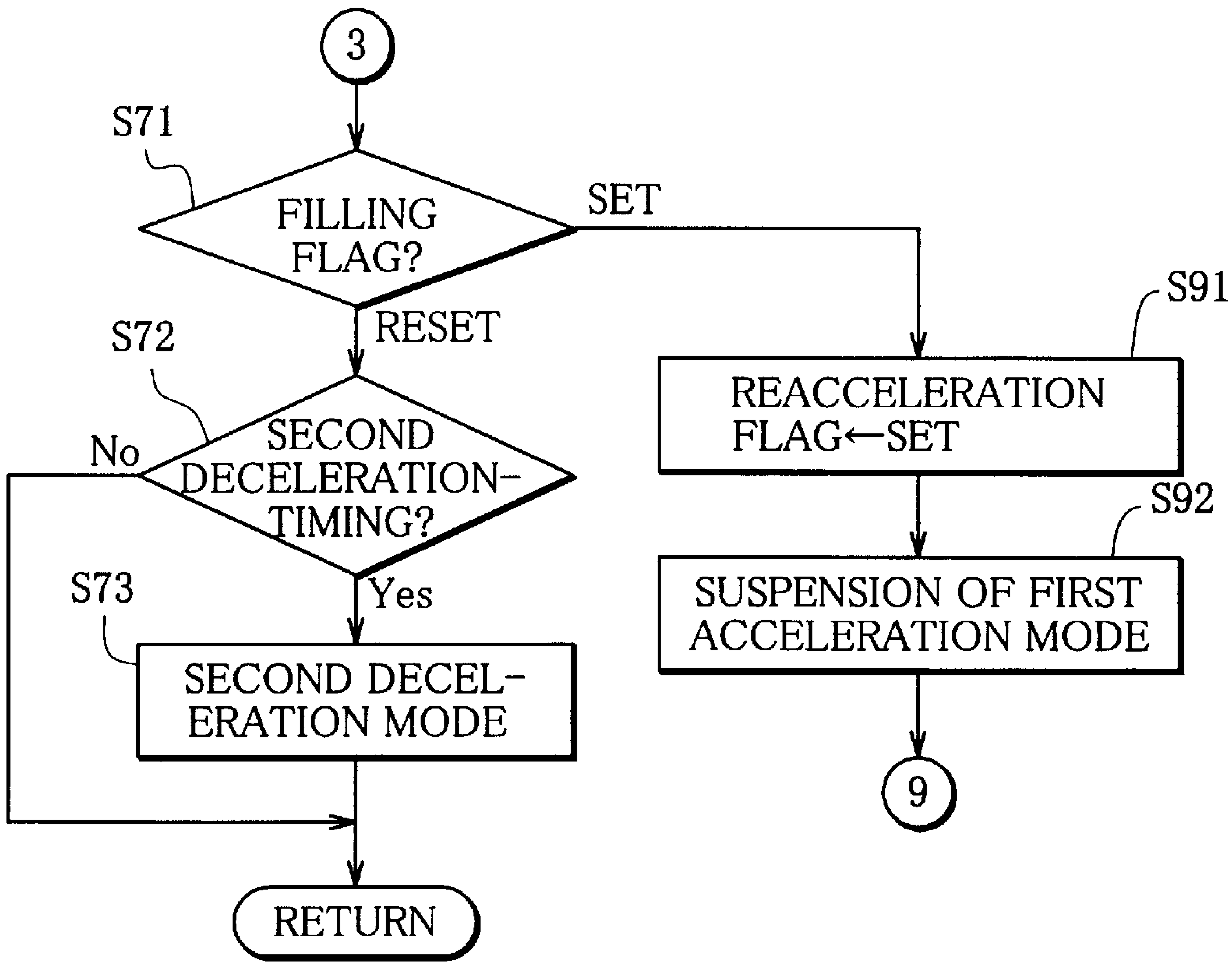

3
S71
FILLING FLAG?
SET
RESET
S91
REACCELERATION FLAG←SET
S72
No
SECOND DECELERATION-TIMING?
S92
SUSPENSION OF FIRST ACCELERATION MODE
Yes
S73
SECOND DECEL-ERATION MODE
9
RETURN

FIG. 23

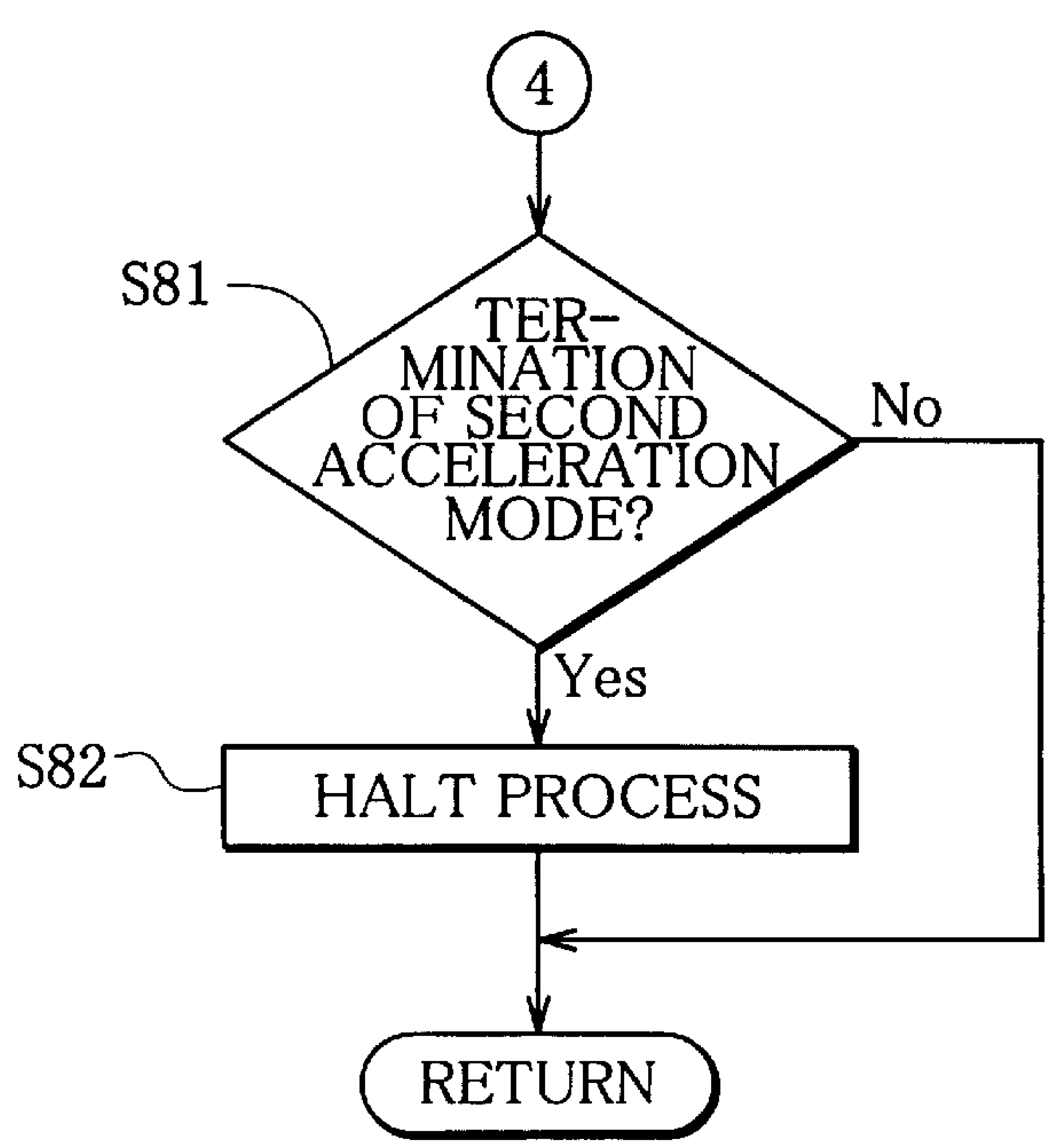

4
S81
TER-MINATION OF SECOND ACCELERATION MODE?
No
Yes
S82
HALT PROCESS
RETURN

FIG. 24

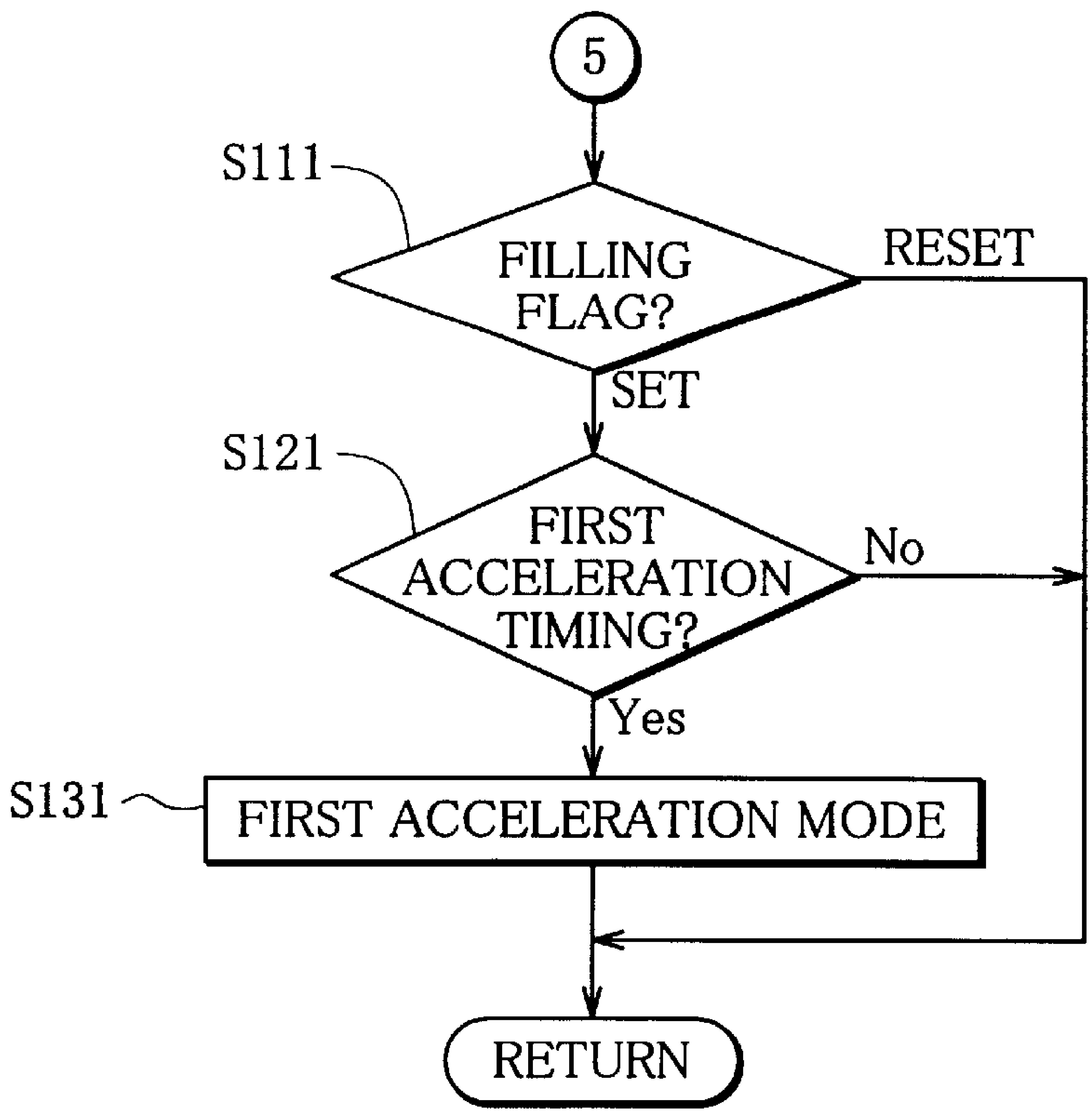

5
S111
FILLING FLAG?
RESET
SET
S121
FIRST ACCELERATION TIMING?
No
Yes
S131
FIRST ACCELERATION MODE
RETURN

FIG. 25

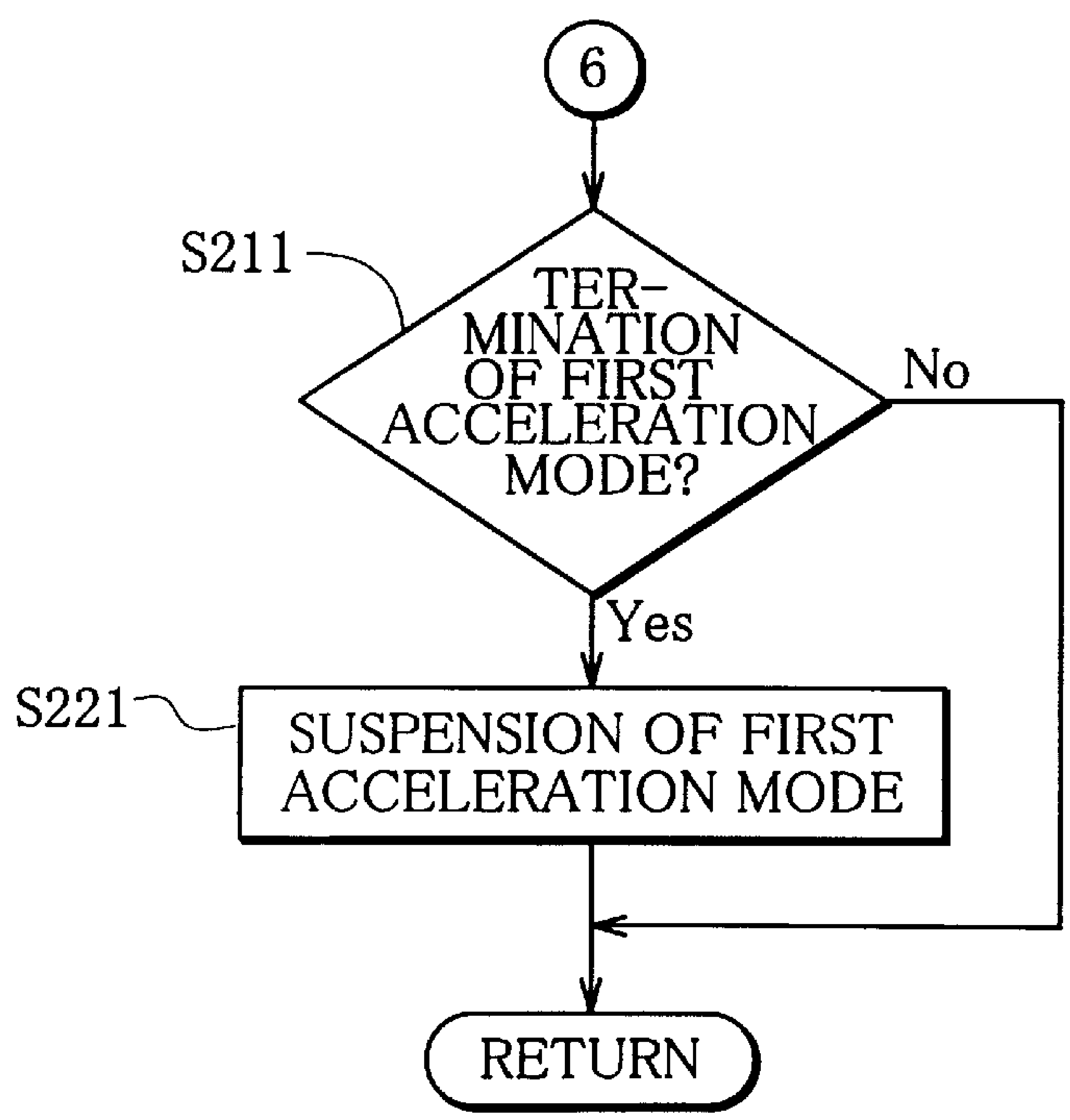

6
S211
TER-MINATION OF FIRST ACCELERATION MODE?
No
Yes
S221
SUSPENSION OF FIRST ACCELERATION MODE
RETURN

FIG. 26

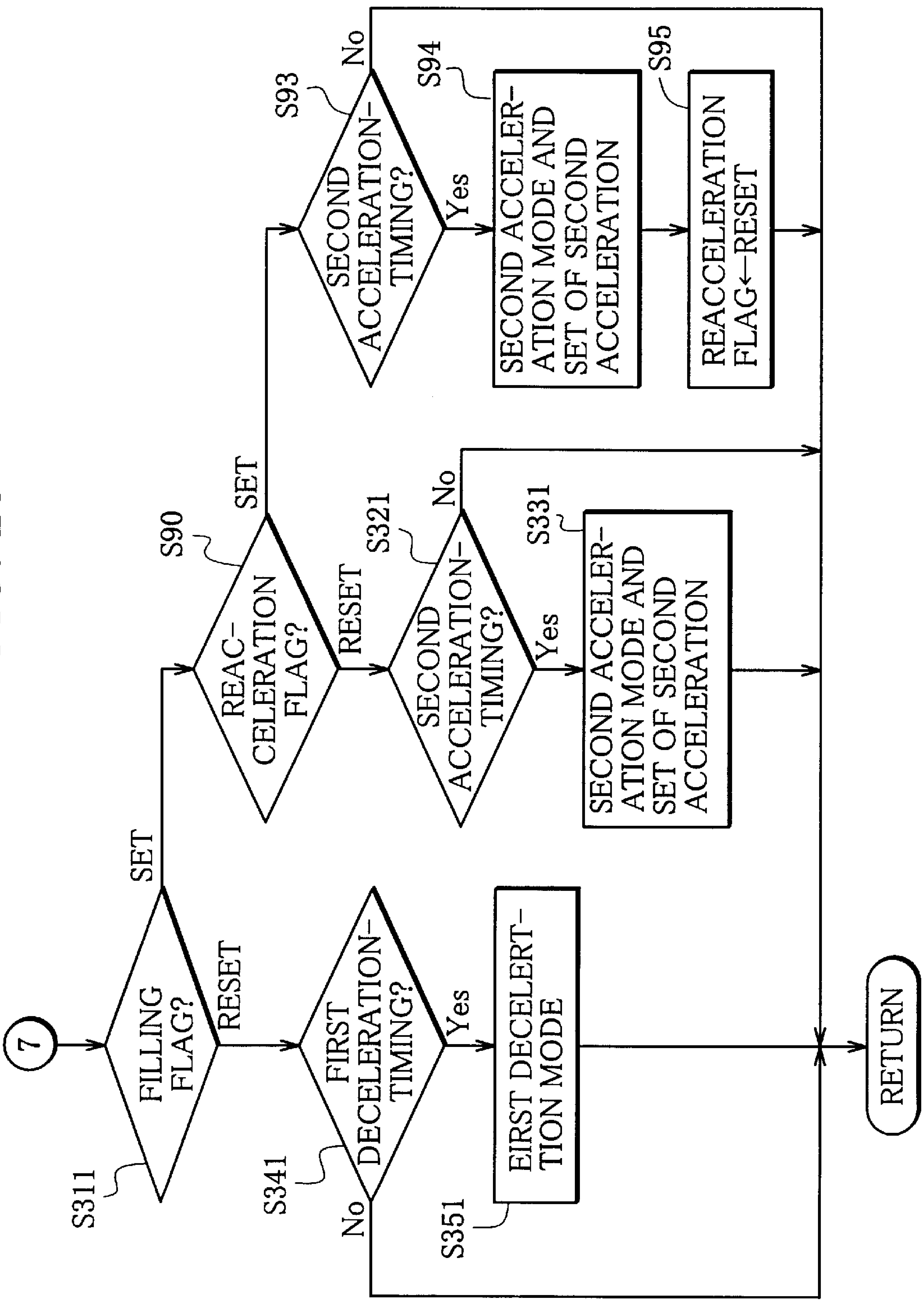

7
S311
FILLING FLAG?
SET
RESET
S90
REAC-CELERATION FLAG?
SET
RESET
S93
SECOND ACCELERATION-TIMING?
Yes
No
S94
SECOND ACCELER-ATION MODE AND SET OF SECOND ACCELERATION
S95
REACCELERATION FLAG←RESET
S321
SECOND ACCELERATION-TIMING?
Yes
No
S331
SECOND ACCELER-ATION MODE AND SET OF SECOND ACCELERATION
S341
FIRST DECELERATION-TIMING?
Yes
No
S351
EIRST DECELERT-TION MODE
RETURN

FIG. 27

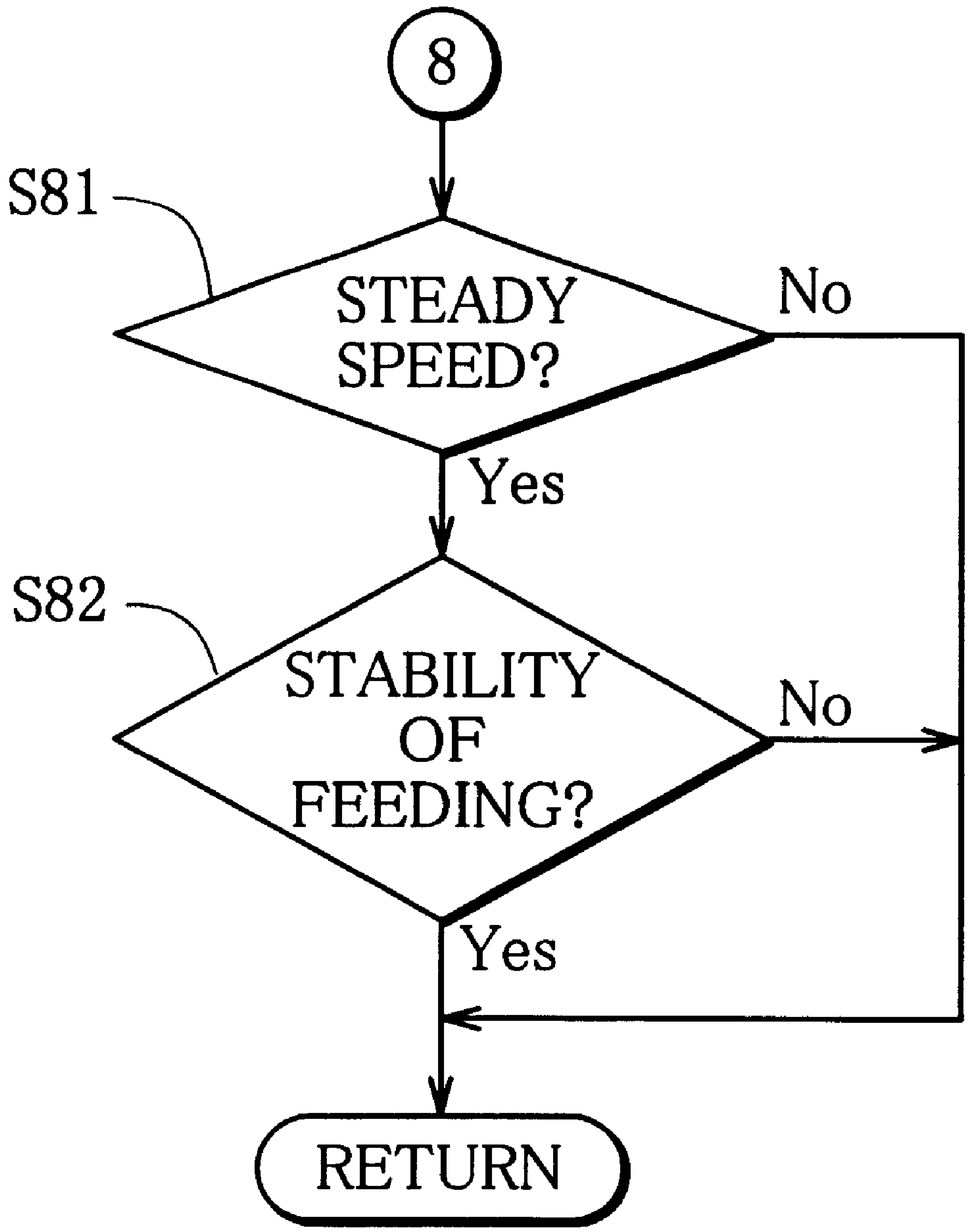

8
S81
STEADY SPEED?
No
Yes
S82
STABILITY OF FEEDING?
No
Yes
RETURN

FIG. 28

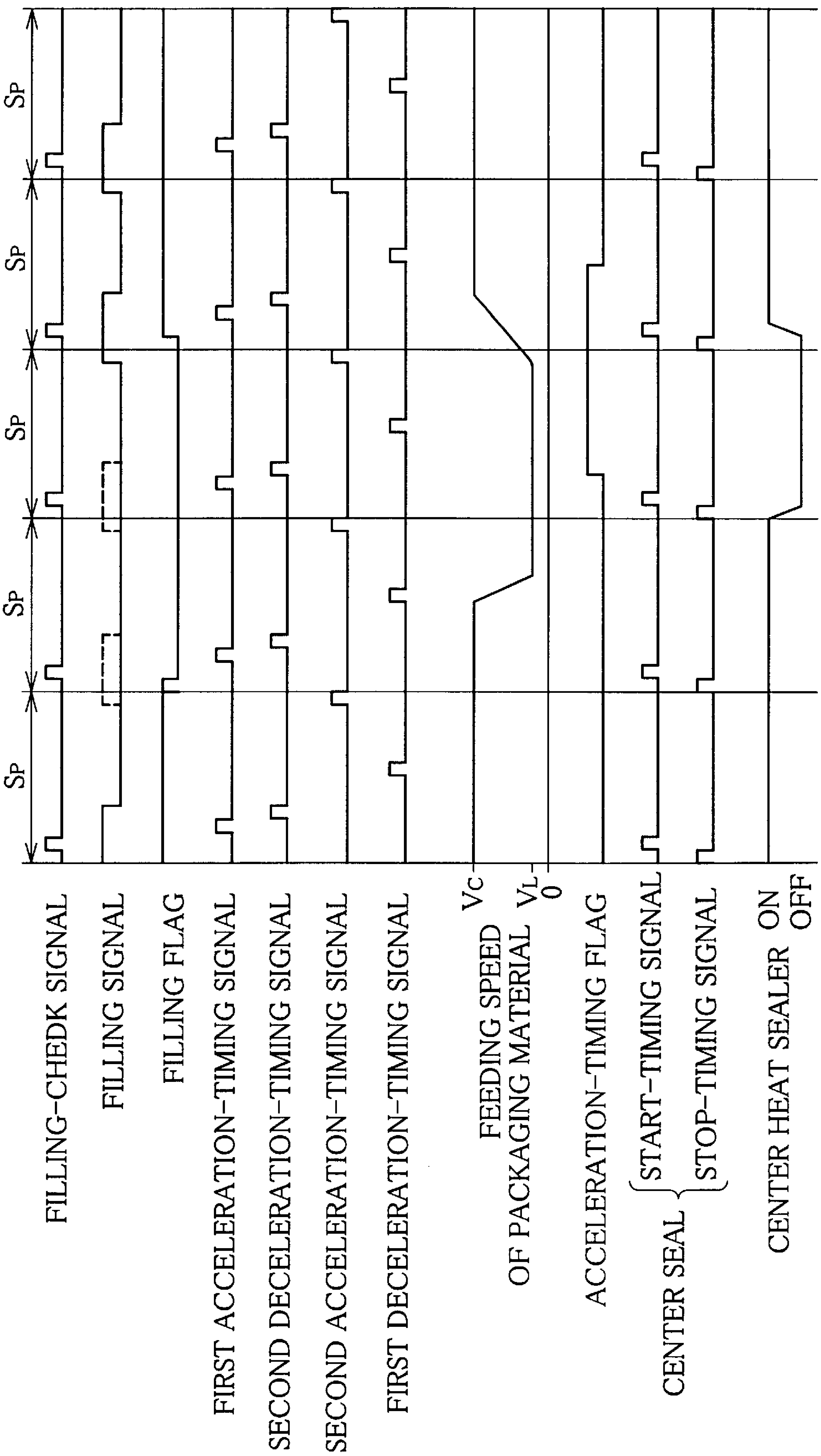

SP
SP
SP
SP
SP
FILLING-CHEDK SIGNAL
FILLING SIGNAL
FILLING FLAG
FIRST ACCELERATION-TIMING SIGNAL
SECOND DECELERATION-TIMING SIGNAL
SECOND ACCELERATION-TIMING SIGNAL
FIRST DECELERATION-TIMING SIGNAL
FEEDING SPEED
OF PACKAGING MATERIAL
VC
VL
0
ACCELERATION-TIMING FLAG
CENTER SEAL
START-TIMING SIGNAL
STOP-TIMING SIGNAL
CENTER HEAT SEALER
ON
OFF

FIG. 29

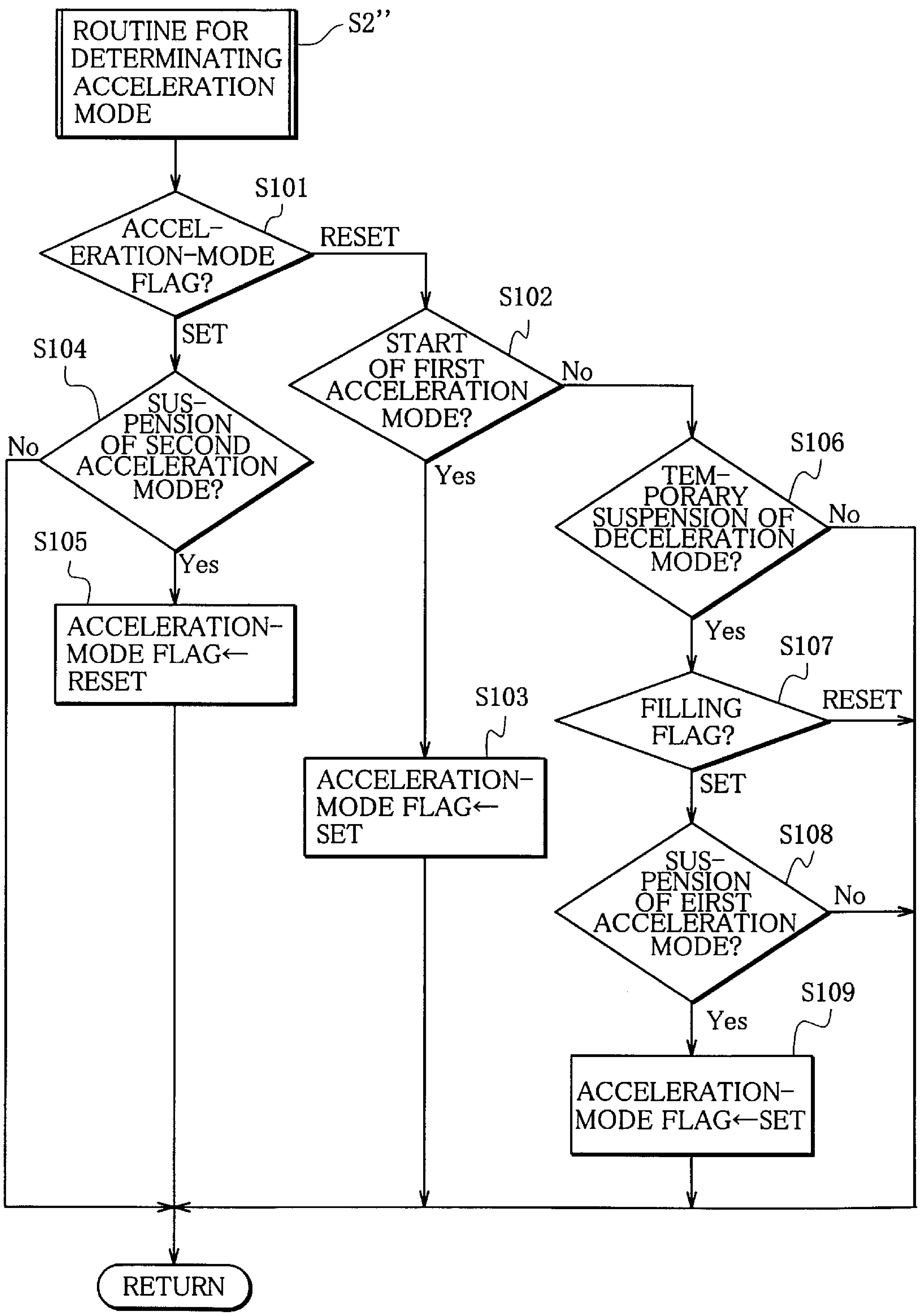
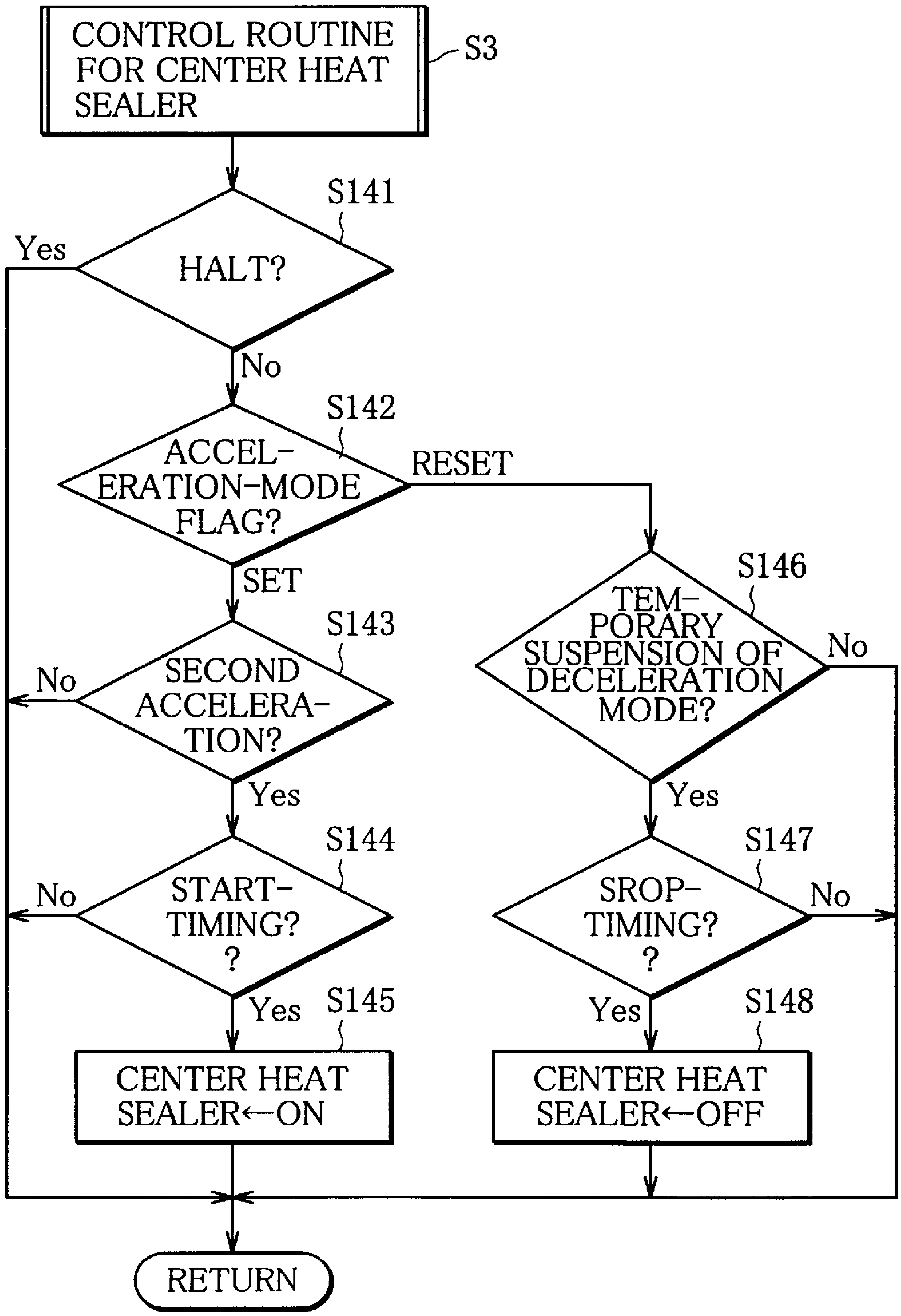

ROUTINE FOR DETERMINATING ACCELERATION MODE
S2''
S101
ACCEL-ERATION-MODE FLAG?
RESET
SET
S102
START OF FIRST ACCELERATION MODE?
No
Yes
S104
SUS-PENSION OF SECOND ACCELERATION MODE?
No
Yes
S105
ACCELERATION-MODE FLAG← RESET
S103
ACCELERATION-MODE FLAG← SET
S106
TEM-PORARY SUSPENSION OF DECELERATION MODE?
No
Yes
S107
FILLING FLAG?
RESET
SET
S108
SUS-PENSION OF EIRST ACCELERATION MODE?
No
Yes
S109
ACCELERATION-MODE FLAG←SET
RETURN

FIG. 30



CONTROL ROUTINE FOR CENTER HEAT SEALER
S3
S141
HALT?
Yes
No
S142
ACCEL-ERATION-MODE FLAG?
RESET
SET
S143
SECOND ACCELERA-TION?
No
Yes
S144
START-TIMING? ?
No
Yes
S145
CENTER HEAT SEALER←ON
S146
TEM-PORARY SUSPENSION OF DECELERATION MODE?
No
Yes
S147
SROP-TIMING? ?
No
Yes
S148
CENTER HEAT SEALER←OFF
RETURN

FIG. 31

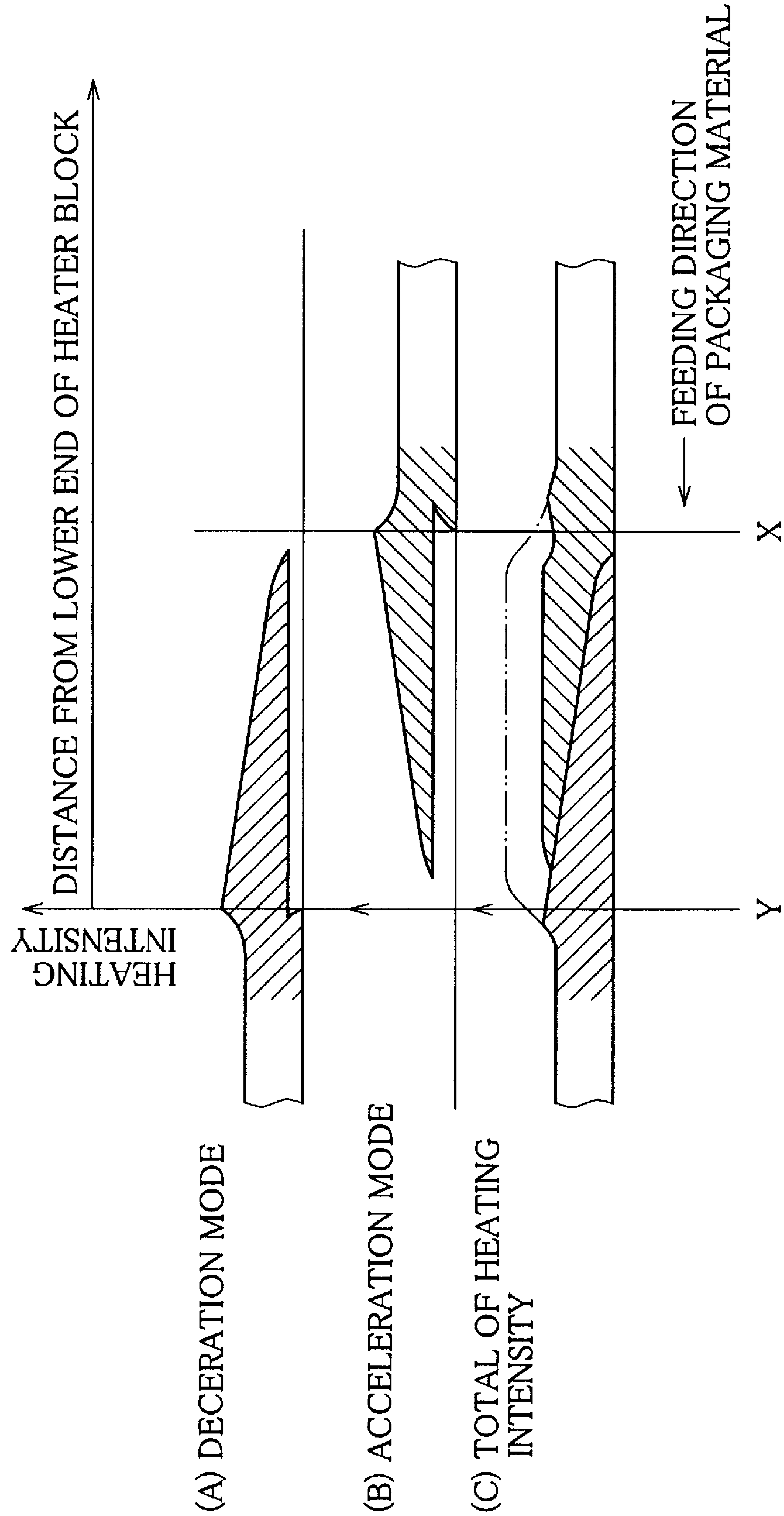
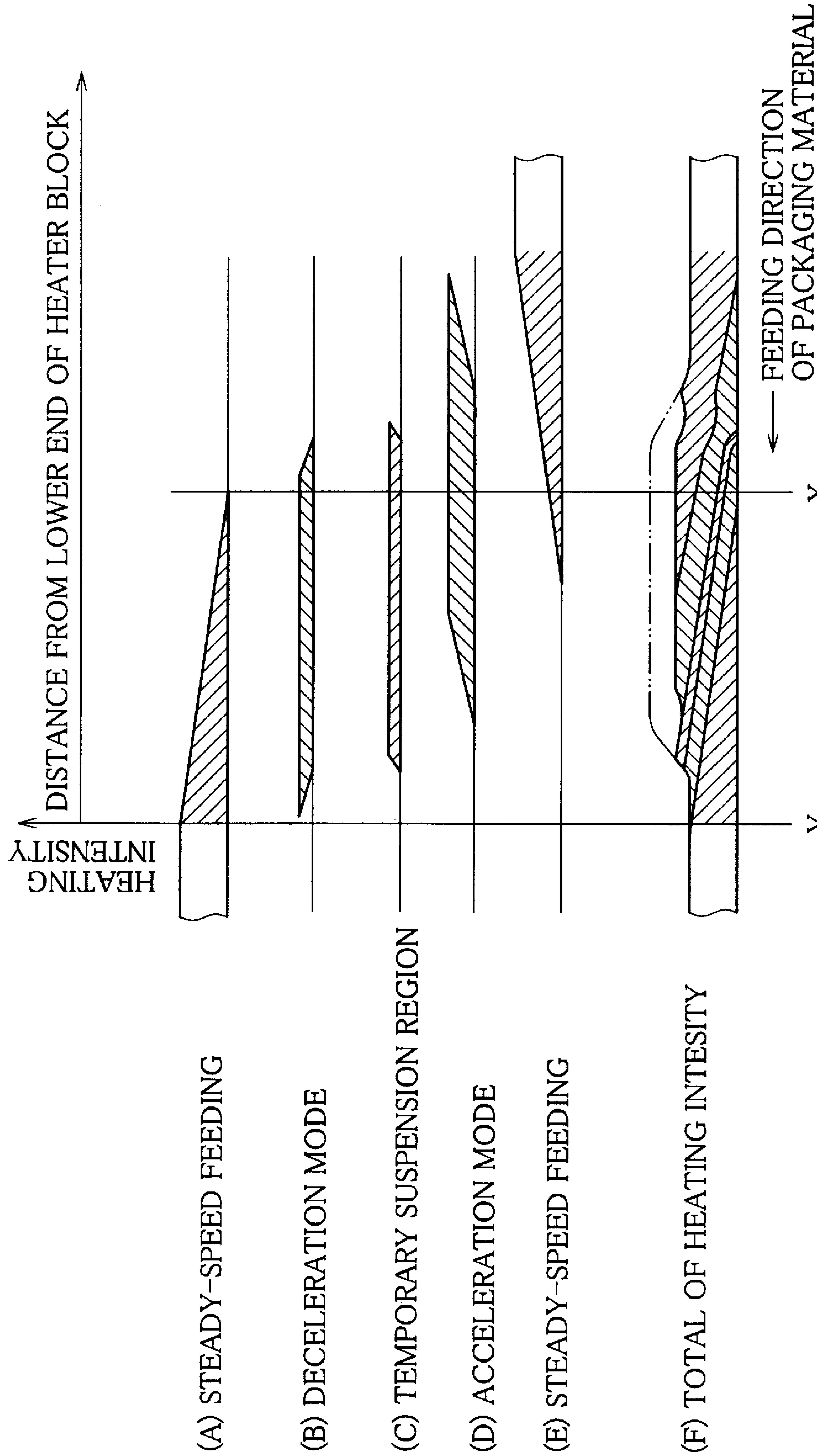

DISTANCE FROM LOWER END OF HEATER BLOCK
HEATING INTENSITY
FEEDING DIRECTION OF PACKAGING MATERIAL
X
Y
(A) DECERATION MODE
(B) ACCELERATION MODE
(C) TOTAL OF HEATING INTENSITY

FIG. 32


DISTANCE FROM LOWER END OF HEATER BLOCK
HEATING INTENSITY
X
Y
FEEDING DIRECTION OF PACKAGING MATERIAL
(A) STEADY-SPEED FEEDING
(B) DECELERATION MODE
(C) TEMPORARY SUSPENSION REGION
(D) ACCELERATION MODE
(E) STEADY-SPEED FEEDING
(F) TOTAL OF HEATING INTESITY

VERTICAL SEALING DEVICE FOR VERTICAL TYPE FORMING, FILLING AND CLOSING MACHINE FOR FLEXIBLE PACKAGES

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a vertical sealing device for a vertical type forming, filling and closing machine for flexible packages, and more particularly, to a vertical sealing device for appropriately controlling the timing of starting or halting a vertical sealing, i.e., center sealing of a cylindrical packaging material when the operation of the packing machine is stopped or restarted.

2. Description of the Related Art

As disclosed in, e.g., Japanese Patent Application Laid-open No.H9-58623 and Japanese Patent Publication No.H5-75616, the above-described type vertical sealing devices include a feed unit of a packaging material and a center heat sealer of the packaging material, and the operation and halting of the feed unit and the center heat sealer are electrically controlled.

The operation of the packing machine is maintained as long as the filling operation of articles into the packaging material is repeated at constant intervals. However, when there are not articles to be filled or the filing of the articles is failed, the operation of the packing machine is stopped. Thereafter, if the filling operation of articles is normally carried out, the operation of the packing machine is also restarted.

Even during a period of transition of the operation of the packing machine when the operation thereof is stopped or restarted, it is necessary to optimally control the feeding operation and the vertical sealing operation of the packaging material in order to prevent defective packaged products from producing. For this reason, both the sealing devices employ an unique control system for the feeding and center sealing of the packaging material during the period of transition of the operation of the packing machine.

In the case of the former sealing device (Japanese Patent Application Laid-open No.H9-58623), the operation of the packing machine is shifted to a transition period, one of the feed unit and the center heat sealer receives a halting signal or an operation signal therefor and then, the other of the feed unit and the center heat sealer receives a halting signal or an operation signal therefor after a predetermined delay time is elapsed therefrom. More specifically, when the operation of the packing machine is stopped, a halting signal is supplied to the feed unit first and then, after the feeding operation of the packing material by the feed unit is completely stopped, a halting signal is supplied to the center heat sealer. Therefore, until the packing material is completely stopped, the seam of superposed opposite side edges of the packing material is subjected to heat seal by the center heat sealer. On the other hand, when the operation of the packing machine is restarted, an operation signal is supplied to the center heat sealer, and after the heat seal of the seam is substantially restarted by the center heat sealer, an operation signal is supplied to the feed unit. Therefore, the seam of the packing material has already been subjected to the heat seal before the feed unit substantially feeds the packing material.

According to the above-described delay control, when the packing machine is stopped or restarted, the seam of the packing material can be subjected to the heat seal for sufficient time by the center heat sealer. Therefore, a portion of the seam of the packing material should not be insufficiently heated, i.e., faulty melting should not be occurred. As a result, it is possible to reliably carry out the center sealing with respect to the articles packed with packaging material.

The latter sealing device (Japanese Patent Publication No.H5-75616) employs a control system concerning the operation of the center heat sealer in which response delay is taken into consideration. More specifically, waiting time in which feeding operation of the packaging material by the feed unit is substantially at rest and response delay time required ON (close) and OFF (open) operation of the center heat sealer are compared with each other. If the response delay time is shorter than the waiting time, the OFF/ON operation of the center heat sealer is permitted. On the other hand, if the response delay time is longer than the waiting time, the OFF/ON operation of the center heat sealer is inhibited, and the center heat sealer is maintained in its ON state.

According to the latter sealing device, the OFF/ON operation of the center heat sealer is automatically controlled in accordance with the waiting time, i.e., the halting time. When the feeding operation of the packaging material is in a rest state for a long time, therefor, the center heat sealer should not be maintained in its ON state, and the seam should not be excessively heated, melted and ruptured.

However, in the case of the former sealing device, although fusion adhesion shortage of the seam of the packaging material can be avoided, a portion of the seam is heated twice by the center heat sealer, and excessive fusion adhesion of the seam is brought about. Such an excessive fusion adhesion disfigures the center seal, and degrades outer appearance quality of the packaged products.

Further, when the operation of the packing machine is stopped or restarted, it is desirable to decelerate or accelerate of the packaging material by the feed unit as gently as possible. If the packaging material is decelerated or accelerated gently, the center seal should not be wrinkled. However, gentle deceleration and acceleration increase the heating time of the seam of the packaging material, which brings about excessive fusion adhesion.

On the other hand, in the latter sealing device, if the above-mentioned waiting time of the packaging material is short, the center heat sealer is maintained in its ON operation. In this case, the deceleration and the acceleration of the packaging material increase the heating time of the seam of the packaging material, which also brings about excessive fusion adhesion.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a vertical sealing device for a packing machine, which does not bring about fusion adhesion shortage and excessive fusion adhesion in a center seal of a packaging material and which does not cause wrinkle in the center seal.

A vertical type packing machine with a vertical sealing device of the present invention includes a filling tube which guides a cylindrically formed packaging material and which is used for intermittently filling at least one article into the packaging material, the packaging material being formed such that both side edges thereof are superposed on each other so as to form a seam extending along the filling tube.

The vertical sealing device for achieving the above object comprises: a feed unit for feeding the packaging material along the filling tube, the feed unit including a constant mode for feeding the packaging material at a steady speed during a normally operating state of the packing machine, and a transition mode for feeding the packaging material at a speed other than the steady speed; a center heat sealer for heating and sealing the seam of the packaging material; and control means for controlling operation of the feed unit and the center heat sealer, the control means having a start timing for starting the operation of the center heat sealer, and a halt timing for halting the operation of the center heat sealer, and at least one of the start timing and halt timing being located in the transition mode of the feed unit.

According to the sealing device, the operation of the center heat sealer is halted after a predetermined time from the halt of operation of the feed unit when the operation of the packing machine is halted, or the center heat sealer is operated after a predetermined time from the start of operation of the feed units when the operation of the packing machine is restarted. Therefore, the seam of the packaging material should not be heated excessively or insufficiently, and it is possible to reliably prevent the fusion shortage or excessive fusion.

More specifically, the feed unit includes, as the transition mode, an acceleration mode for accelerating the packaging material from a halt state to the steady speed when the filling operation of the article into the packaging material is restarted from a halt state of the packing machine, and a deceleration mode for decelerating the packaging material from the steady speed to the halt state when a non-filling operation of the article occurs during the normally operation of the packing machine.

In this case, the control means has the start timing located in the acceleration mode, or has the halt timing located in the deceleration mode. More preferably, the control means may have he start timing and halt timing located in the acceleration and deceleration modes, respectively.

A period of time of each of the acceleration mode and the deceleration mode substantially may coincide with one packing cycle time required for forming one packaged products which contains the article during the steady operating state of the packing machine. In this case, the packaging material is gently accelerated and decelerated in the acceleration mode and the deceleration mode without largely lowering the packing ability of the packing machine. As a result, it is possible to effectively prevent wrinkles at the center seal.

Further, the feed unit may include, as the transition mode, temporary suspension regions in the acceleration mode and the deceleration mode, respectively. In this case, it is preferable that the packaging material is fed at the same speed in the temporary suspension regions.

If the feeding speed of the packaging material in the temporary suspension regions is the same, the control means can operate the feed unit continuously so as to directly shift the feeding state of the packaging material from the temporary suspension region in the deceleration mode to the temporary suspension region in the acceleration mode when a situation in which non-filling operation of the article does not occur continuously. In this case, the packing ability of the packing machine is not lowered substantially.

In such a state, the control means may have the start timing located after termination of the temporary suspension region in the acceleration mode, and may have the halt timing located within the temporary suspension region in the deceleration mode.

When no wrinkles at the center seal is more important than the packing ability of the packing machine, a period of time of the acceleration mode is set equal to or longer than the one packing cycle time, and a period of time of the deceleration mode is set equal to or shorter than the one packing cycle time.

Further scope of applicability of the present invention will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirits and scope of the invention will become apparent to those skilled in the art from this detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will become more fully understood from the detailed description given hereinbelow and the accompanying drawings which are given by way of illustration only, and thus, are not limitative of the present invention, and wherein:

FIG. **1** is a schematic perspective view of a vertical type forming, filling and closing machine for flexible packaged products;

FIG. **2** is an enlarged front view of a portion of the machine shown in FIG. **1**;

FIG. **3** is a detailed view showing the feed unit of a vertical sealing device of the machine of FIG. **1**;

FIG. **4** is a plan view showing a center heat sealer of the vertical-sealing device;

FIG. **5** is a view showing motion of a top heat sealer of the machine;

FIG. **6** is a schematic block diagram of a controller for a center seal control;

FIG. **7** is a timing chart showing a relation between a feeding state of a packaging material fed by the feed unit and ON/OFF operation of the center heat sealer;

FIG. **8** is a flowchart showing a main routine for the center seal control;

FIG. **9** is a flowchart showing details of a check routine shown in FIG. **8**;

FIGS. **10** and **11** are flowcharts showing details of a control routine for the feed unit shown in FIG. **8**;

FIG. **12** is a flowchart showing details of the control routine for the center heat sealer shown in FIG. **8**;

FIGS. **13***a*–**13***c* are views showing heating intensity during a deceleration mode and an acceleration mode of the packaging material;

FIG. **14** is a graph showing peel strength of a center seal obtained immediately after the operation of the machine is restarted from its halt state;

FIG. **15** is a graph showing a relation between the revolution speed of a servomotor of the feed unit and a feeding speed of the packaging material;

FIG. **16** is a schematic view showing a controller according to a modification;

FIG. **17** is a timing chart showing a relation between a feeding state of the packaging material fed by the feed unit and the ON/OFF operation of the center heat sealer;

FIG. **18** is a flowchart showing a modification of a control routine for the feed unit;

FIGS. **19** to **27** are flowcharts showing details of the feeding control routine in FIG. **18**;

FIG. **28** is a timing chart showing a relation between a feeding state of the packaging material fed by the feed unit and the ON/OFF operation of the center heat sealer;

FIG. **29** is a flowchart showing details of the judging routine in FIG. **18**;

FIG. **30** is a flowchart showing the control routine for the center heat sealer;

FIG. **31** is a graph showing the heating intensity that the seam of the packaging material receives when the ON/OFF operation of the center heat sealer is carried out with timing shown in FIG. **17**; and

FIG. **32** is a graph showing the heating intensity that the seam of the packaging material receives when the ON/OFF operation of the center heat sealer is carried out with timing shown in FIG. **28**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. **1**, a vertical type forming, filling and closing machine for flexible packages, that is, a packing machine includes a filling tube **2** which extends upward and downward. An upper end of the tube **2** is integrally connected to a lower hopper **4**. The lower hopper **4** is connected to an upper hopper **8** through a shutter device **7**. The upper hopper **8** is connected to a weight feeder **6** which accumulates therein a large number of articles in bulk. The weight feeder **6** feeds or drops the articles by a predetermined weight into the shutter device **7** through the upper hopper **8**. When the shutter device **7** is opened, measured articles are dropped into the tube **2** through the lower hopper **4** from the shutter device **7**. At that time, the weight feeder **6** receives an opening signal from the shutter device **7** and then outputs a filling signal. It is also possible to use a volumetric or counting feeder instead of the weight feeder **6**.

The filling tube **2** is provided with a former **10**, which surrounds the filling tube **2** at the underside of the lower hopper **4**. The former **10** guides a packaging material F fed from a roll R toward the filling tube **2**. Thereafter, the packaging material F is pulled down along the filling tube **2**. The packaging material F is made of a film, which can be melted when heated. When the packaging material F passes through the former **10**, the packaging material F is formed into a cylindrical shape which surrounds the tube **2**. Then, both the side edges of the packaging material F pass through a lapping unit and are superposed on each other into a predetermined form.

More specifically, the lapping unit **12** is disposed directly below the former **10** as shown in FIG. **2**, and has a pair of guide plates **14** and **16**. These guide plates **14** and **16** are arranged apart from an outer peripheral surface of the tube **2** by a predetermined distance, and define a guide passage therebetween. In the course of the passing of both the side edges of the packaging material F, the side edges are superposed on each other so as to form a seam. Concretely, the lapping unit **12** forms a seam aimed at fin seal or lap seal.

The above described tube **2**, the former **10** and the lapping unit **12** are attached to a horizontal mounting board **18**. The mounting board **18** is detachably mounted to a frame **20** of the packing machine through left and right supporting/locking mechanism **19**. The tube **2**, the former **10** and the lapping unit **12** are replacement parts which are replaced in accordance with a width of the packaging material F, i.e., packaged product to be produced.

The packing machine includes a vertical sealing device for the packing material F. The vertical sealing device has a pair of feed units **21** for feeding the packaging material F, and a center heat sealer **24**. The feed units **21** are disposed on opposite sides of the filling tube **2**. Since the pair of feed units **21** are symmetric with respect to the tube **2**, a structure of one of the feed units **21** will be explained below.

As shown in FIG. **3**, the feed unit **21** includes an endless suction belt **22**. The belt **22** extends upward and downward, and wound around upper and lower timing belt pulleys **23**. Each of the pulleys **23** includes a pulley shaft which is rotatably supported by a base **25** of the feed unit **21**. The pulley shaft of the lower pulley **23** is connected to an output shaft of a servomotor **27**. When the servomotor **27** is driven, the suction belt **22** runs in one direction. The base **25** includes a suction box **29** which extends upward and downward between the upper and lower pulleys **23**. The suction box **29** has a suction chamber (not shown) defined therein, a guide groove (not shown) formed on a side surface at the side of the filling tube **2**, and a connection hole **31** formed in a rear surface at the side of the base **25**. The connection hole **31** is connected to a negative pressure source through a suction hose, and the interior of the suction chamber is maintained at a predetermined negative pressure. In the drawing, the suction hole, the negative pressure source and an air pressure control circuit for them are omitted.

The guide groove extends along the belt **22** for guiding the running motion of the belt **22**. The guide groove is provided at a bottom surface thereof with a large number of suction holes (not shown) which are in communication with the suction chamber. Therefore, the belt **22** in the guide groove can receive a predetermined suction force from the suction chamber.

The base **25** is slidably mounted to upper and lower horizontal guide rods **33**. The guide rods **33** are supported at their opposite ends by side plates **37** which are mounted to a cross plate **39**. The cross plate **39** extends horizontally, and opposite ends thereof are connected to the frame **20** of the packing machine.

The upper and lower guide rods **33** pass through movable stoppers **41**. Each of the movable stoppers **41** is located between the corresponding side plate **37** and base **25** for sliding movement on the guide rods **33**. The movable stoppers **41** includes a lock mechanism **43** which fixes the movable stopper **41** at arbitrary position on the guide rods **33**.

The base **25** includes an air cylinder **45** which is horizontally mounted to a rear surface thereof. The air cylinder **45** has a piston rod which extends toward the corresponding movable stopper **41** and is connected to the movable stopper **41**. If the piston rod of the air cylinder **45** extends from a state shown in FIG. **3**, the corresponding feed unit **21**, i.e., the belt **22** thereof moves toward the tube **2** and approaches the cylindrical packaging material F which surrounds the tube **2**. In the approaching state of the belt **22**, when the suction force is supplied to the belt **22**, the belt **22** can suck the packaging material F. Further, when the belt **22** runs in this state, the packaging material F is fed downward along the tube together with the belt **22**. With this feeding operation, the former **10** forms the flat packaging material F into the continuous cylindrical shape, and the lapping unit **12** forms both the side edges of the packaging material F into the continuous seam.

As shown in FIGS. **1** and **2**, the center heat sealer **24** is disposed in the vicinity of the filling tube **2**. In more detail, the center heat sealer **24** is located below the lapping unit **12**. Therefore, the seam of the packaging material F passes through a space between the center heat sealer **24** and the tube **2** and at that time, the center heat sealer **24** melts and fuses the seam of the packaging material F into an united form by heating. That is, the side edges of the packaging material F are adhered to each other by the heat seal.

As shown in FIG. **4**, the center heat sealer **24** is mounted to a distal end of a supporting arm **34**. The supporting arm

34 horizontally extends in front of the tube **2**. A proximal end of the supporting arm **34** is connected to a slider **38** through a pivot shaft **36**. In more detail, the slider **38** has a bracket **40**, and the bracket **40** rotatably supports the pivot shaft **36**. Therefore, the supporting arm **34** can rotate around the pivot shaft **36** in a horizontal plane.

Further, the supporting arm **34** houses a lock mechanism (not shown) in the proximal end thereof. The lock mechanism has a lock handle **42** which projects upward from the supporting arm **34**. By operating the lock handle **42**, the lock mechanism fastens the supporting arm **34** to the bracket **40** and releases the fastening of the supporting arm **34**. Therefore, when the fastening of the supporting arm **34** is released, the supporting arm **34** can rotate between a closed position shown with a solid line and an opened position shown with a two-dot chain line. In order to facilitate the rotating motion of the supporting arm **34**, the supporting arm **34** is provided at its distal end with a handle **44**.

The bracket **40** further includes two hooks **46** respectively corresponding to the closed position and the opened position of the supporting arm **34**. When the supporting arm **34** is in the closed position, the corresponding hook **46** receives a lock shaft **48** of the lock mechanism, thereby selectively fixing the supporting arm **34** to one of the closed position and the opened position thereof.

The slider **38** is slidably mounted to upper and lower guide rods **50**. These guide rods **50** horizontally extend in a direction perpendicular to an axis of the filling tube **2**, and proximal ends of the guide rods **50** are supported by the frame **20** of the packing machine. The slider **38** also houses a lock mechanism (not shown) having a lock handle **52**. By operating the lock handle **52**, the lock mechanism fastens the slider **38** to the guide rods **50** and releases the fastening of the slider **38**.

When the fastening of the slider **38** is released, the slider **38** can slide on the guide rods **50**. Such a sliding movement is allowed so as to adjust a distance between the supporting arm **34** and the tube **2** in the closed position in accordance with a diameter of the filling tube **2**. In order to facilitate the sliding movement of the slider **34**, the slider **34** also has a handle **54**. In FIG. **4**, the maximum diameter and the minimum diameter of the filling tube **2** are shown with one-dot chain lines respectively.

The distal end of the supporting arm **34** is provided at its inner surface with a bracket **56** which supports a plate **58**. The plate **58** extends upward and downward along the filling tube **2**, and has upper and lower guide rods **60**. These guide rods **60** horizontally project from the plate **58** toward the tube **2**. Each of the guide rods **60** slidably passes through a plate **62**, and the plate **62** is opposed to the plate **58**.

The plate **62** includes a heater block **66** and an air cylinder **76**. The heater block **66** houses a heater therein and vertically extends in the axial direction of the tube **2**. The air cylinder **76** is placed between the upper and lower guide rods **60** and has a piston rod **78**. The piston rod **78** passes through the plate **62**, and a distal end of the piston rod **78** is connected to the plate **58**. In the drawing, a feeder circuit for the heater block **66** and a pneumatic circuit for the air cylinder **76** are omitted.

The filling tube **2** is provided at its outer surface with a packaging material guide or a seam guide (not shown). The seam guide is opposed to a tip end face of the heater block **66**, and extends along the tube **2**.

If the piston rod **78** of the air cylinder **76** is contracted from the state shown in FIG. **4**, the plate **62** is moved together with the heater block **66** toward the plate **58** while being guided by the guide rods **60**. Therefore, the heater block **66** moves away from the tube **2**. On the other hand, if the piston rod **78** of the air cylinder **76** is extended, the heater block **66** advances toward the tube **2** and approaches the tube **2**. In the approaching state with respect to the tube **2**, the seam of the packaging material F is sandwiched between the tip end of the heater block **66** and the seam guide. In this state, if the heater block **66** has been heated to a predetermined temperature, and the seam of the packaging material F passes through the heater block **66**, the heater block **66** satisfactorily heats and melts the seam. As a result, the heater block **66** continuously carries out the heat seal for the seam, thereby forming the center seal (vertical seal) in the packaging material F.

The supporting arm **34** further includes a plurality of guard rods **72**. These guard rods **72** extend toward the filling tube **2** from the supporting arm **34**, and are disposed such as to surround the heater block **66**, the air cylinder **76** and the like. Distal ends of guard rods **72** support a guard plate **74**. The guard rods **72** and the guard plate **74** prevent inadvertent access to the heater block **66**. However, the guard plate **74** has an aperture for the heater block **66**. The aperture allows the heater block **66** to approach the filling tube **2** and retreat from the tube **2**.

As shown in FIG. **2**, the filling tube **2** is provided at its lower end with a pair of fins **28**. These fins **28** extend downward such as to gradually separate from each other from the lower end of the tube **2**. Therefore, after the heat seal of the packaging material F, and the packaging material F comes out from the lower end of the tube **2**, the fins **28** push and widen the material F in the lateral direction to form the packaging material F into a flat cylindrical shape.

As shown in FIG. **1** schematically, the packing machine further includes a top heat sealer **26** below the filler tube **2**. The top heat sealer **26** is operated in association with the operation (feeding of the packaging material F) of the pair of feed units **21**. Therefore, the packaging material F which has been subjected to the center seal is subjected to top seals at a predetermined intervals. Further, after the top seal, the top heat sealer **26** cuts the packaging material F from a center of a seal width of the top seal, and separates the packaging material F into individual packages.

The above-described top seal as well as cut operation, and feeding of the articles into the filling tube **2**, i.e., into the packaging material F are carried out alternately and as a result, each of the packages becomes a packaged product in which the articles are fed.

Referring to FIG. **5**, movement of the top heat sealer **26** is shown more concretely. The top heat sealer **26** includes a heater block **80** and a receiving block **82**, and these blocks **80** and **82** move upward and downward in association with feeding operation of the packaging material F, and close such as to approach each other and open such as to separate from each other. That is, the top heat sealer **26** can open or close simultaneously with rising or lowering movement. Therefore, when the top heat sealer **26** closes, the packaging material F is sandwiched between the blocks **80** and **82**, and the top seal of the packaging material F is carried out. A movable blade (not shown) is embedded in one of the heater block **80** and the receiving block **82**, and the other one of them includes a receiving groove (not shown) for the movable blade. When the top seal of the packaging material F is completed, the movable blade projects from one of the blocks into the receiving groove of the other block, thereby cutting the packaging material F.

As shown with a solid line in FIG. **5**, when the top heat sealer **26** is in a closed state, the heater block **80** and the receiving block **82** approach each other to sandwich the packaging material F between them. At that time, the top heat sealer **26** is being lowered, and the lowering speed of the top heat sealer **26** is the same as the feeding speed of the packaging material F. In such a lowering process of the top heat sealer **26**, the articles are fed into the packaging material F, and then the top seal of the packaging material F is carried out.

When the top heat sealer **26** reaches in the vicinity of its lower limit position, the movable blade projects toward the packaging material F and cuts the packaging material F at a center position of a seal width of the top seal. Thereafter, the top heat sealer **26** opens, that is, the heater block **80** and the receiving block **82** are separated from each other, the packaged product P (see FIG. **5**) is released from the top heat sealer **26** and is dropped therefrom and then, the top heat sealer **26** rises toward its upper limit position. The top heat sealer **26** repeats the above-described action, thereby dropping individual packaged products P continuously.

The packaged product P dropped from the top heat sealer **26** is received by a chute **30** (see FIG. **1**), and is supplied from the chute **30** to a belt conveyer **32**. The belt conveyer **32** transfers the packaged products P toward a box-packing machine (not shown).

In order to control the operation of the vertical sealing device, i.e., the pair of feed units **21** and the center heat sealer **24**, the packing machine comprises a controller **84**. The controller **84** includes a microcomputer having a microprocessor, an input/output interface, memory devices such as RAM and ROM, and peripheral circuits.

As shown in FIG. **6**, the input/output interface **86** for the controller **84** is electrically connected to the pair of feed units **21** and the center heat sealer **24**. The microprocessor can receive a filling signal S_F from the weight feeder **6** through the input/output interface **86**, and can output a waiting signal S_W to the weight feeder **6**. The microprocessor outputs control signals to the pair of feed units **21** through the input/output interface **86**, and controls the supply of suction pressure to the suction belt **22**, the driving of the servomotor **27** and the like based on these control signals. Only the driving signal S_M is indicated as the control signal in FIG. **6**, and the driving signal S_M controls the driving of the servomotor **27** in the feed unit **21**. On the other hand, the servomotor **27** outputs a halting signal S_S, and the halting signal S_S is supplied to the microprocessor through the input/output interface **86**.

Further, the microprocessor delivers control signals to the center heat sealer **24** through the input/output interface **86**, and controls the electricity feeding to the heater of the heater block **66** and the change-over of a solenoid operated valve (not shown) which operates the air cylinder **76** based on the control signals. In FIG. **6**, only a change-over signal S_C for control the change-over of the solenoid operated valve is shown.

More specifically, in addition to a control-arithmetic unit **88** connected to the input/output interface **86**, the microprocessor further includes a first generating section **90** for generating filling-check signals, a second generating section **92** for generating mode-check signals, a deceleration-mode timer **94** and an acceleration-mode timer **96**. These generating sections **90** and **92** as well as the timers **94** and **96** are connected to the control-arithmetic unit **88**.

The RAM and ROM are also electrically connected to the unit **88**. The unit **88** reads control program for the center seal stored in the ROM and data such as initial values and the like stored in the RAM, and controls the weight feeder **6** and the vertical sealing device in accordance with the control program. At the time of such control, the unit **88** can temporarily store necessary data in the RAM.

The first generating section **90** generates a filling-check signal S_{FC} at a constant cycle. If the weight feeder **6** is in a steady operating state, that is, the articles are fed from the weight feeder **6** into the tube **2** at constant time intervals and the weight feeder **6** output the filling signal S_F at a constant intervals, the generating cycle of the filling-check signal S_{FC} coincides with the output cycle S_P of the filling signal S_F. Further, the generating timing of the filling-check signal S_{FC} is determined within an output period of the filling signal S_F.

As shown in FIG. **7**, when the weight feeder **6** is in the steady operating state, the filling signals S_F become pulse signals having a constant cycle, and the output cycle S_P of the filling signals S_F in this case coincides with one packaging cycle required for producing one packaged product P when the packing machine is in its steady operating state.

The second generating section **92** generates the mode-check signals S_{MC} at the same cycle as the generating cycle of the filling-check signals S_{FC}, and the generating timing of the mode-check signals S_{MC} is set between timings at which the filling-check signals S_{FC} are generated. Therefore, the filling-check signal S_{FC} and the mode-check signal S_{MC} are alternately generated. Here, the generating cycle of the mode-check signal S_{MC} coincides with the output cycle S_P of the above-described filling signal S_F when the weight feeder is in the steady operating state.

When the packing machine is already operated, the control-arithmetic unit **88** of the controller **84** repeatedly carries out a main routine for the center seal shown in FIG. **8** in a predetermined control cycle. A control routine includes a check routine **S1** for checking the filling operation of the articles, and control routines **S2** and **S3** for controlling operations of the feed units **21** and the center heat sealer **24**.

Check Routine

Details of the check routine are shown in FIG. **9**. The control-arithmetic unit **88** determines whether the filling check signal S_{FC} is generated from the first generating section **90** (step **S10**). If "Yes" in step **S10**, the unit **88** determines whether the filling signal S_F is being output from the weight feeder **6** (step **S11**). If "Yes" here, the unit **88** sets a filling flag.

If "No" in step **S11**, the unit **88** resets the filling flag (step **S13**), and sets a shutdown flag (step **S14**). When the filling flag is set or reset, the unit **88** completes the check routine **S1**, and executes the control routine **S2** for the feed units **21**.

When the packing machine (weight feeder **6**) is in the steady operating state, the decision result in step **S11** always become "Yes". In this case, the filling flag is maintained in a state where the filling flag is always set as apparent from FIG. **9**.

Whereas, when the accumulating amount of articles in the weight feeder **6** is insufficient or the weight feeder **6** does not drop the articles due to trouble of the weight feeder **6** itself, the weight feeder **6** does not output the filling signal S_F. In this time, there is no filling signal S_F which should be output, such a filling signal S_F is indicated with a broken line in FIG. **7**. In such a state, the decision result in step **S11** becomes "No", and the filling flag is changed over from "set" to "reset" as shown in FIG. **9**, and the shutdown flag is set.

When the shutdown flag is set, the control-arithmetic unit **88** outputs the waiting signal S_W to the weight feeder **6**. Upon reception of the waiting signal S_W, the weight feeder **6** halts the filling operation of the articles. Therefore, since the weight feeder **6** outputs no filling signal S_F thereafter, the decision result in step **S11** always becomes "No". As a result, the filling flag is maintained in the reset state, and the shutdown flag is maintained in the set state.

Control Routine for the Feed Units

Details of the control routine S2 are shown in FIGS. **10** and **11**. First, the control-arithmetic unit **88** determines whether the mode-check signal S_{MC} is generated from the second generating section **92** (step S**20**). If "Yes" in step S**20**, the unit **88** determines the state of the filling flag (step S**21**).

If the unit **88** determines that the filling flag is set in step S**21**, the unit **88** determines whether the feeding speed of the packaging material F corresponds to a steady speed V_C, or whether the feeding operation is halted (step S22). If the decision result here is "V_C", this means that the packing machine is normally operating. In this case, the unit **88** bypasses the subsequent step S**23**, and executes step S**26** shown in FIG. **11**. However, if the decision result in step S**22** is "HALT", the unit **88** sets an acceleration flag in step S**23** and then, executes step S**26**. Here, it is possible for the unit **88** to determine that the packaging material F is halted based on the halting signal S_S sent from the feed units **21**.

On the other hand, if the decision result in step S**21** is "RESET", the unit **88** determines the feeding speed of the packaging material F as in the step S**22** (step S**24**). If the decision result here is "HALT", this means that the operation of the packing machine is halted. In this case, the unit **88** bypasses the subsequent step S**25** and executes step S**26** shown in FIG. **11**. Whereas, if the decision result in step S**24** is "V_C", i.e., if the packaging material F is still in the feeding state, the unit **88** sets the deceleration flag in step S**25** and then, executes step S**26**.

The unit **88** determines the state of the acceleration flag in step S**26** shown in FIG. **11**. If the decision result here is "RESET", the unit **88** determines the state of the deceleration flag (step S**27**). If the decision result here is "RESET" again, i.e., if the packing machine is in the steady operation state or the shutdown state, the unit **88** completes the control routine S**2**, and executes the next control routine S**3**.

However, if the decision result in step S**27** is "SET", the unit **88** decelerates the servomotor **27** of each of the feed units **21**, i.e., the feeding speed of the packaging material F at a predetermined rate (step S**28**). Here, at the point of time when the deceleration of the servomotor **27** is started, the packaging material F is still fed at the steady speed V_C even though the filling flag is reset, i.e., even though there is non-filling operation of the articles into the filling tube **2** from the weight feeder **6**.

As shown in FIG. **7**, after the filling flag is changed over from "set" to "reset", the deceleration mode of the packaging material F is started from the instant when the first mode-check signal S_{MC} is generated. The deceleration of the packaging material F is determined such that the packaging material F is completely stopped at the instant when the next mode-check signal S_{MC} is generated. That is, the deceleration of the packaging material F in the deceleration mode is gently performed from the state of the steady speed feeding using the generation cycle in the mode-check signal S_{MC}, i.e., the entire region of the above-described one packing cycle time S_P.

Next, the unit **88** determines whether the packaging material F is halted (step S**29**), and if "No", the deceleration-mode timer **94** is turned ON (step S**30**) and then, the next control routine S**3** is executed. Here, the count time by the deceleration-mode timer is set to about half of the generation cycle of the mode-check signal S_{MC}, i.e., of the time period of the deceleration mode for example.

The deceleration in step S**28** is carried out repeatedly, and if the decision result in step S**29** becomes "Yes" and the feeding operation of the packaging material F is halted, the unit **88** resets the deceleration flag (step S**31**) and resets the shutdown flag (step S**32**). If the shutdown flag is reset in this manner, the unit **88** halts the output of the waiting signal S_W to the weight feeder **6**, thereby allowing the weight feeder **6** to restart its operation.

On the other hand, if the decision result in step S**26** is "SET", the unit **88** accelerates the servomotor **27** of each of the feed units **21** and feeds the packaging material F at a predetermined acceleration (step S**33**). The start of acceleration of the packaging material F means that the packaging material F is fed from the halt state as a result of restarting the filling operation of the articles from the weight feeder **6**.

When the feeding operation of the packaging material F is once shifted to the deceleration mode as described above, it is necessary to reset the shutdown flag in order to restart the operation of the weight feeder **6**.

As shown in FIG. **7**, the acceleration mode of the packaging material F is started from the instant when the first mode-check signal S_{MC} is generated after the filling flag is changed over from "reset" to "set". The acceleration in the acceleration mode is determined such that the steady speed feeding of the packaging material F is completed when the next mode-check signal S_{MC} is generated. That is, the packaging material F is gently accelerated using the generation cycle of the in the mode-check signal S_{MC}, i.e., the entire region of one packing cycle time.

Next, the unit **88** determines whether the packaging material F is in the state of the steady-speed feed (step S**34**). If the decision result here is "No", the acceleration-mode timer is turned ON (step S**35**) and then, the next control routine S3 is executed. Here, the count time of the acceleration-mode timer is set to about half of the generation cycle of the mode-check signal S_{MC}, i.e., of the time period (see FIG. 7) of the acceleration mode for example.

When the acceleration in step S**33** is repeatedly carried out and then the decision result in step S**34** becomes "Yes", i.e., when the packaging material F assumes the steady speed feeding state, the unit **88** resets the acceleration flag (step S36) and executes the control routine S3.

Control Routine for the Center Heat Sealer

Details of the control routine are shown in FIG. **12**. The control-arithmetic unit **88** determines the state of the acceleration-mode timer (step S37), and if the decision result here is "OFF", the unit **88** determines the state of the deceleration-mode timer (step S38). If the decision result here is also "OFF", the unit **88** completes the control routine S3, and executes the above-described check routine S**1** and subsequent routine repeatedly. That is, the control routine S**3** can not be substantially executed unless both the acceleration-mode timer and the deceleration-mode tire are ON. In this case, the operation of the center heat sealer **24** is not controlled and is maintained in the ON state for heating the seam of the packaging material F.

If the decision result in step S**38** is "ON", the feeding operation of the packaging material F is shifted from the steady feeding mode to the deceleration mode. In such a state, the unit **88** determines whether the counted time of the deceleration-mode timer has been elapsed, i.e., whether time is up (step S**39**). If the decision result here is "No", the unit **88** bypasses steps S**40** and S**41**, and completes the control routine S**3**.

During the deceleration mode of the packaging material F, when the decision result in step S**39** becomes "Yes", the unit **88** turns OFF the center heat sealer **24** in step S**40**. More specifically, the heater block **66** of the center heat sealer **24** is retreated from the filling tube **2** by the air cylinder **76**.

Then, the unit **88** resets the deceleration flag and turns OFF the deceleration-mode timer in step **S41**.

Therefore, the unit **88** should not turn OFF the center heat sealer **24** immediately after the feeding operation of the packaging material F is shifted to the deceleration mode. In more detail, the center seal for the packaging material F by means of the center heat sealer **24**, i.e., ON operation of the center heat sealer **24** is halted when the time period set in the deceleration-mode timer has been elapsed during the deceleration mode of the packaging material F as shown in FIG. **7**.

Here, the advancing and retreating movements of the heater block **66** with respect to the filling tube **2** are carried out by the air cylinder **76**. Therefore, even though the time period set in the deceleration-mode timer is elapsed, the center heat sealer **24** is not changed over to the OFF operation immediately as apparent from FIG. **7**. However, the OFF operation of the center heat sealer **24** is completed during the deceleration mode. For this reason, the packaging material F is completely halted after the center heat sealer **24** is turned OFF (see step **S29**).

On the other hand, if the decision result in step **S37** is "ON", the feeding operation of the packaging material F is shifted from the halting state to the acceleration mode. In this case, the unit **88** determines whether the time period set in the acceleration-mode timer is elapsed (step **S42**). If the decision result here is "No", the unit **88** bypasses the nest steps **S43** and **S44**, and completes the control routine **S3**. Here, if the feeding operation of the packaging material F is shifted from the halting state to the acceleration mode, the above-described deceleration mode has already been carried out. Therefore, at that time, the center heat sealer **24** is in the OFF operation state, and the heater block **66** is in the retreated position separated away from the filling tube **2**.

Thereafter, during the execution of the acceleration mode for the packaging material F, if the decision result in step **S42** becomes "Yes", the unit **88** turns ON the center heat sealer **24** in step **S43**. At this time, the heater block **66** advances toward the filling tube **2**, and the center seal of the packaging material F is restarted. Then, in step **S44**, the unit **88** resets the acceleration flag, and turns OFF the acceleration-mode timer.

As described above, the center heat sealer **24** is turned ON immediately, not at the time when the acceleration mode of the packaging material F is started but at the time when the time period set ins the acceleration-mode timer is elapsed. As shown in FIG. **7**, a delay occurs in the changing over from the OFF operation to the ON operation of the center heat sealer **24**, but the ON operation of the center heat sealer **24** is completed during the acceleration mode, and then the feeding speed of the packaging material F becomes the steady speed V_C (see step **S34**).

FIG. **7** also shows the timing of rising/lowering movement and timing of opening/closing movement of the top heat sealer **26**.

In such a state that a filling operation of the articles ends in failure and the feeding operation of the packaging material F is shifted from the steady speed mode to the deceleration mode, the center heat sealer **24** is turned OFF after a predetermined delay time is elapsed from the start of the deceleration mode. Therefore, the heating intensity T_1 applied to the packaging material F by the heater block **66** is varied as shown in (A) of FIG. **13**. That is, when the feeding speed of the packaging material F is the steady speed V_C, the heating intensity T_1 is constant. However, if the feeding operation of the packaging material F is shifted to the deceleration mode, the heating intensity T_1 is once increased, and is gradually decreased as the center heat sealer **24** is retreated from the filling tube **2**. Further, even if the OFF operation of the center heat sealer **24** is completed, the feeding of the packaging material F is continued. For this reason, when the packaging material F is stopped after that, the seam of the packaging material F have non-heat seal portion N which at the region of the heating block **66** is not heated from the upper end of the heater block **66** through a predetermined length. In FIG. **13**, X and Y respectively represents the upper end position and the lower end position of the heater block **66**.

Thereafter, when the feeding operation of the packaging material F is shifted from the halting state to the acceleration mode in which the feeding speed is accelerated to the steady speed V_C, the center heat sealer **24** is turned ON after a predetermined delay time is elapsed from the starting of the acceleration mode. Therefore, a heating intensity T_2 applied to the packaging material F is varied as shown in (B) of FIG. **13**. In this case, even if the acceleration mode is started, the seam of the packaging material F, which at the region of the heater block **66** is not heated from the lower end of the heater block **66** through a predetermined distance. When the center heat sealer **24** is turned ON after that, the heating intensity T_2 is gradually increased. Thereafter, the feeding speed of the packaging material F reaches the steady speed V_C, the heating intensity T_2 is once decreased, and becomes constant.

Therefore, when the feeding operation of the packaging material F is returned to the steady speed from the halted state, the seam of the packaging material F which were at the region of the heater block **66** is heated at the heating intensity T which is the sum of the heating intensities T_1 and T_2 as shown in (C) of FIG. **13**. In this case, as apparent from FIG. **13**, since the overlapped portions of the heating intensities T_1 and T_2have lower intensity levels respectively. Thus, even if the seam of the packaging material F is heated at both the heating intensities T_1 and T_2, the seam should not be heated excessively.

As a result, after the packaging material F is stopped, even if the feeding operation of the packaging material F is restarted at the steady speed, the seam of the packaging material F should not be excessively or insufficiently fused and connected, and the center seal should not be disfigured. These heating intensities T_1 and $T_2$are appropriately determined while taking into the consideration the fact that the packaging material F is heated at the heating intensity which is the sum of the heating intensities T_1 and T_2.

FIG. **14** shows the peel strength of the center seal obtained when the steady speed feeding of the packaging material F from its halt state is restarted. In FIG. **14**, L represents a portion of the center seal which corresponds to the length of the heater block **66** and is obtained immediately after the restart of the feeding of the packaging material F. Although the center of the L portion is heated at the heating intensity which is the sum of the heating intensities T_1 and T_2, the peel strength is not excessively increased as compared with opposite ends of the L portion.

In this respect, if the start of the acceleration mode for the packaging material F and the ON operation of the center heat sealer **24** are performed simultaneously, or when the center heat sealer **24** is turned ON before the start of the acceleration mode for the packaging material F, the fusion adhesion of the seam of the packaging material F is carried out excessively, and the peel strength of the center seal at the excessive fusion adhesion portion is extremely increased as compared with other portions as shown with the two-dot line in FIG. **14**.

Further, during the deceleration mode and the acceleration mode for the packaging material F, the deceleration and the acceleration of the packaging material F are gently carried out. That is, as shown with a thin solid line in FIG. **15**, the acceleration of the servomotor **27** is low. Therefore, the feeding operation of the packaging material F excellently follows the acceleration of the servo motor **27** as shown with the one-dot line, and wrinkle should not be caused in the center seal of the packaging material F. On the contrary if the acceleration of the servomotor **27** is high as shown with the thin broken line in FIG. **15**, fluctuation is liable to be caused in the feeding of the packaging material F as shown with the two-dot line, which becomes a cause of generation of wrinkle in the center seal. Even in the deceleration mode for the packaging material F, it is possible to effectively prevent the wrinkle from being generated in the center seal for the same reason.

Since the deceleration mode and the acceleration mode for the packaging material F are completed within one packing cycle period S_P of the packing machine, defective packaged products P should not be produced when the packing machine is halted or restarted.

The present invention should not be limited to the above-described one embodiment, and various modifications are possible. For example, it is most preferable that the center heat sealer **24** is turned OFF during the deceleration mode for the packaging material F and the center heat sealer **24** is turned ON during the acceleration mode for the packaging material F as in the embodiment. However, for carrying out the present invention, the center heat sealer **24** may be turned ON or OFF only during one of the deceleration mode and the acceleration mode.

Further, in the embodiment, when a filling operation of articles is skipped during the intermittent filling process, the operation of the weight feeder **6** is halted and then, the feeding speed of the packaging material F is once halted completely from the steady speed. Thereafter, when the intermittent filling process is restarted, the feeding speed of the packaging material F is returned to the steady speed. Therefore, the feeding speed of the packaging material F is only controlled linearly between the halted state to the steady speed. However, the feeding speed can also be controlled stepwisely during the deceleration or acceleration mode.

In this case, the structure of the controller **84** of the vertical sealing device is changed from that shown in FIG. **6** to that shown in FIG. **16**.

A controller **84** in FIG. **16** comprises a generating section **100** for generating a first deceleration-timing signal, a generating section **102** for generating a second deceleration-timing signal, a generating section **104** for generating a first acceleration-timing signal, a generating section **106** for generating a second acceleration-timing signal, a generating section **108** for generating a start-timing signal for a center seal, and a generating section **110** for generating a stop-timing signal for the center seal, instead of the generation section **92** for generating the above-described mode-check signal, the deceleration-mode timer **94** and the acceleration-mode timer **96**. These generating sections **100** to **110** respectively output timing signals in the same one packing cycle period S_P as shown in FIG. **17**.

More specifically, suppose that each of the packing cycle period S_P is divided into an initial stage, an intermediate stage and a late stage, for example. In this case, if the filling-check signal is generated in the initial stage, the generating section **104** generates the first acceleration-timing signal subsequent to the filling-check signal in the initial stage, and the generating section **102** generates the second deceleration-timing signal at the end of the initial stage. The generating section **106** generates the second acceleration-timing signal at the end of the late stage, and the generating section **100** generates the first deceleration timing signal at the middle of the intermediate stage.

The generating section **108** generates the start-timing signal at the same timing as the filling-check signal in the initial stage, and the generating section **110** generates the stop-timing signal prior to the start-timing signal in the initial stage.

In the case of this embodiment, the control-arithmetic unit **88** does not use the shutdown flag and thus, does not output the waiting signal S_W to the weight feeder **6**.

A control routine for the feed units **21** of the controller **84** shown in FIG. **16** comprises two sub-routines, i.e., a feed-control routine S2' and a determination routine S2" for an acceleration mode as shown in FIG. **18**. These routines S2' and S2" will be explained in detail below.

Feed Control Routine

Details of the routine S2' are shown in FIGS. **19** to **27**. In a flowchart in FIG. **19**, concerning the feeding operation of the packaging material F, the control-arithmetic unit **88** of the controller **84** successively determines:

a) whether the feeding operation is halted (step S**100**);

b) whether the first acceleration mode is being selected (step S**200**);

c) whether the acceleration mode is temporarily discontinued or suspended (step S**300**);

d) whether the second acceleration mode is being selected (step S**400**);

e) whether the steady speed is maintained (step S**500**);

f) whether the first deceleration mode is being selected (step S**600**);

g) whether the deceleration mode is temporarily discontinued or suspended (step S**700**); and

h) whether the second deceleration mode is being selected (step S**800**).

If the decision results are all "No", the unit **88** determines that the feed units **21** are under abnormal condition, and halts the packing machine (abnormal stop) (step S**1000**).

When the packing machine is being operated normally, the packaging material F is fed at the steady speed V_C. Therefore, in such a state, the decision result in step S**500** becomes "Yes", and the unit **88** executes a routine shown in FIG. **20**.

When the packing machine is being operated normally, a length of the packaging material F fed during one packing cycle period S_P coincides with a length of one packaged product P, and the length of the fed packaging material F is expressed as the product of the one packing cycle period S_P and the feeding speed of the packaging material F.

In the routine shown in FIG. **20**, the unit **88** first determines the state of the filling flag (step **S51**). If the decision result here is "SET", the unit **88** executes the main routine shown in FIG. **8**. Therefore, during the steady operation of the packing machine, the unit **88** repeatedly executes the determinations in steps S**500** and **S51** only.

When a filing operation of the articles is skipped and the decision result in step **S51** becomes "RESET", the unit **88** determines whether the first deceleration-timing signal is generated (step **S52**). If the decision result here becomes "Yes", the unit **88** performs the deceleration mode, i.e., the first deceleration mode of the packaging material F (step **S53**). By performing the first deceleration mode, the feeding of the packaging material F is decelerated at a first deceleration as shown in FIG. **17**.

When the feeding operation of the packaging material F is shifted to the first deceleration mode, the decision result in step **S600** becomes "Yes" according to the routine shown in FIG. **19**, and in this case, the unit **88** executes a routine shown in FIG. **21**. In this routine, the unit **88** determines whether the first deceleration mode is completed or terminated (step **S61**). More specifically, the unit **88** determines whether a predetermined time T_D is elapsed from the start of the first deceleration mode. Here, the predetermined time T_D is set to time shorter than an interval between the timing when the first deceleration-timing signal is generated and the timing when the second acceleration-timing signal is generated.

If the decision result in step **S61** becomes "Yes", the unit **88** discontinues or suspends the first deceleration mode (Step **S62**), and maintains the feeding speed of the packaging material F at a speed V_L which is a speed at the time when the first deceleration mode is discontinued (see FIG. **17**). Here, the speed V_L is set to about ⅕ to ⅖ of the steady speed V_C.

Thereafter, since the decision result in step **S700** becomes "Yes" according to the routine in FIG. **19**, the unit **88** executes a routine shown in FIG. **22**. In this routine, the unit **88** first determines the state of the filling flag (step **S71**). If the decision result here becomes "RESET", this means a situation where "non-filling operation" of articles is continued (see the filling signal shown with broken lines) as apparent from FIG. **17**. In this case, the unit **88** determines whether the second deceleration-timing signal is generated, i.e., whether the current time is in the second deceleration timing (step **S72**). Until the decision result here becomes "Yes", the feeding speed of the packaging material F is maintained at the speed V_L. If the decision result in step **S72** becomes "Yes", the unit **88** performs the feeding operation of the packaging material F in the second deceleration mode (step **S73**). In this second deceleration mode, the packaging material F is decelerated at a second deceleration which is smaller than the first deceleration.

If the second deceleration mode is performed, the decision result in step **S800** becomes "Yes" according to the routine shown in FIG. **19**, and the unit **88** executes a routine shown in FIG. **23**. In this routine, the unit **88** determines whether the second deceleration mode is completed or terminated (step **S81**). More specifically, in step **S81**, the unit **88** determines whether the feeding speed of the packaging material F is 0, and if the decision result here becomes "Yes", halt process of the packaging material F is carried out (step **S82**). At this instant, the deceleration mode is completed.

When the feeding operation of the packaging material F is halted, the decision result in step **S100** becomes "Yes" according to the routine shown in FIG. **19**, and thus, the unit **88** executes a routine shown in FIG. **24**. In this routine, the unit **88** determines the state of the filling flag (step **S111**). As long as the decision result here is maintained at "RESET", the packaging material F is maintained in the halt state.

However, when the feeding operation of the article is restarted and as a result, the decision result in step **S111** becomes "SET", the unit **88** determines whether the first acceleration-timing signal is generated, i.e., whether the current timing is in the first acceleration timing (step **S121**). At the time when the decision result here becomes "Yes", the unit **88** performs the acceleration mode, i.e., the first acceleration mode of the packaging material F (step **S131**). That is, after the filling flag is changed over from "RESET" to "SET", when the next first acceleration-timing signal is generated, the first acceleration mode of the packaging material F is carried out. In this first acceleration mode, the unit **88** or the feeding units **21** feeds the packaging material F at a predetermined first acceleration in FIG. **17**.

When the first acceleration mode is carried out, the decision result in step **S200** becomes "Yes" according to the routine shown in FIG. **19**, and the unit **88** executes a routine shown in FIG. **25**. In this routine, the unit **88** determines whether the first acceleration mode is completed or terminated (step**S211**). More specifically, the unit **88** determines whether a predetermined time T_A (see FIG. **17**) is elapsed from the start of the first acceleration mode. Here, the predetermined time T_A is set shorter than the above-described predetermined time T_D, and the first acceleration of the packaging material F in the first acceleration mode is set such that the feeding speed of the packaging material F reaches the above-described speed V_L when the predetermined time T_A of the packaging material F in the first acceleration mode is elapsed.

When the decision result in step **S211** becomes "Yes", the unit **88** discontinues or suspends the first acceleration mode of the packaging material F (step **S222**). Therefore, the feeding speed of the packaging material F is maintained at the speed V_L.

When the first acceleration mode of the packaging material F is discontinued, the decision result in step **S300** becomes "Yes" according to the routine shown in FIG. **19**, and the unit **88** executes a routine in FIG. **26**. In this routine, the unit **88** determines the state of the filling flag (step **S311**). Here, when the routine in FIG. **26** is carried out for the first time, the decision result in step **S311** becomes always "Yes" as apparent from FIG. **17**. Therefore, the unit **88** then determines the state of a reacceleration flag which will be described later (step **S90**). At this time, since the reacceleration flag is not set, the decision result in step **S90** becomes "RESET", the unit **88** determines whether the second acceleration-timing signal is generated, i.e., whether the current timing is in the second acceleration timing (step **S321**). If the decision result here becomes "Yes", the unit **88** performs the second acceleration mode of the packaging material F (step **S331**). In this step **S331**, the packaging material F is accelerated at a second acceleration. The absolute value of the second acceleration is smaller than that of the first deceleration.

When the second acceleration mode for the packaging material F is carried out, the decision result in step **S400** becomes "Yes" according to the routine in FIG. **19**, and the unit **88** executes a routine shown in FIG. **27**. In this routine, the unit **88** determines whether the feeding speed of the packaging material F reaches the steady speed V_C (step **S81**). If the decision result here becomes "Yes", the unit **88** determines whether the feeding of the packaging material F is stabilized (step **S82**). More specifically, the unit **88** determines whether a predetermined time period T_S is elapsed after the feeding speed of the packaging material F reaches the steady speed V_C. Here, the predetermined time T_S is a minimum time required until the feeding of the packaging material F is stabilized after the feeding speed of the packaging material F reaches the steady speed V_C. For example, the predetermined time T_S is a time between the instant when the feeding speed of the packaging material F reaches the steady speed V_C and the instant when the first deceleration-timing signal is generated, and is about ⅙ of the one packing cycle period S_P.

When the decision result in step **S82** becomes "Yes", the acceleration mode is complete. Thereafter, the above-described top seal and cut of the packaging material F are carried out, and the packing machine is returned to its steady operating condition. Here, the above-described first deceleration and the second acceleration of the packaging material F are respectively set such that length of the packaging material F fed in the deceleration mode and the acceleration mode coincides with length of one packaged product P.

The top seal and cut can be carried out only when the packaging material F is fed at the steady speed, but also during the deceleration mode for the packaging material F, i.e., during the first deceleration mode. In this case, the lowering speed of the top heat sealer **26** is controlled in accordance with the deceleration of the packaging material F.

As apparent from FIG. **17**, the acceleration mode of the packaging material F is started from the time when the first acceleration-timing signal is generated, and is completed when the feeding operation of the packaging material F is brought into the steady t speed condition. Therefore, the acceleration mode is carried out during one packing cycle period S_P or more. Whereas, the deceleration mode of the packaging material F is started when the first deceleration-timing signal is generated and completed until the next first deceleration-timing signal is generated, and the period of the deceleration mode is shorter than the one packing cycle period S_P.

On the other hand, during execution of the second acceleration mode, if the decision result in step **S311** of the routine shown in FIG. **26** becomes "RESET", this means that there is a non-filling operation of the articles again immediately after the intermittent feeding process is restarted. In this case, the unit **88** determines whether the current timing is the first deceleration timing (step **S341**). If the decision result here becomes "Yes", the unit **88** performs the first deceleration mode for the packaging material F (step **S351**).

As a result, in the routine shown in FIG. **19**, the decision result in step **S600** becomes "Yes", and the unit **88** repeatedly carries out steps in the routine shown in FIG. **21** and subsequent routines, thereby starting the above-described deceleration mode again. The deceleration mode for the packaging material F at that time is carried out in succession to completion of the acceleration mode as shown in the one-dot line in FIG. **17**. Even if "existence" and "absent" of the feeding operation of the articles are alternately appear, the feeding of the packaging material F is once accelerated to the steady speed and then, is decelerated.

When the routine shown in FIG. **22** is repeatedly carried out, i.e., when the feeding operation of the packaging material F is in a temporary suspension region in the deceleration mode, if the decision result in step **S71** becomes "Yes", the unit **88** sets the reacceleration flag (step **S91**), and discontinues or suspends the first acceleration mode (step **S92**) as in the step **S221** in FIG. **25**. Thereafter, the unit **88** executes the step **S300** in the routine of FIG. **19** as described above.

Here, a situation in which the decision result in step **S71** is "Yes" means that the next filling operation of the articles is immediately restarted after the feeding operation of the packaging material F is shifted to the deceleration mode. In this case, the unit **88** executes the routine shown in FIG. **26** through steps **S91**, **S92** and **S300** (FIG. **17**) without performing the above-described second deceleration mode (step **S73**). That is, as shown in FIG. **28**, the feeding operation of the packaging material F is immediately shifted from the temporary suspension region in the deceleration mode to the temporary suspension region in the acceleration mode. As a result, the change over from the deceleration mode to the acceleration mode for the packaging material F is carried out without stopping the packaging material F.

When the routine shown in FIG. **26** is carried out in this manner, the decision result in step **S90** becomes "SET", and the unit **88** executes the step **S93** and subsequent steps. In step **S93**, the unit **88** determines whether the second acceleration-timing signal is generated as in step **S321**, i.e., whether the current timing is the second acceleration timing. At the time when the decision result here becomes "SET", the unit **88** performs the second acceleration mode for the packaging material F (step **S94**). In step **S94**, the unit **88** newly sets a second acceleration of the packaging material F, and resets the reacceleration flag (step **S95**). Thereafter, the unit **88** executes step **S400** in FIG. **19** (see the routine in FIG. **27**). Here, attention should be paid to a point that the second acceleration set in step **S94** is different from the second acceleration set in step **S331**. That is, it is necessary to take into consideration the fact that the feeding operation of the packaging material F is continued at the speed V_L between the suspension regions of the deceleration and acceleration modes and to set the second acceleration in step **S94** such that feeding length of the packaging material F in the deceleration mode and the acceleration mode coincides with length of one packaged product P.

Determination Routine in Acceleration Mode

FIG. **29** shows a determination routine. This determination routine is executed subsequent to the above-described control routine S2'. Here, the control-arithmetic unit **88** determines the state of an acceleration-mode flag (step **S101**), and when the decision result here is "RESET", the unit **88** determines whether the above-described first acceleration mode is started (step **S102**). When the decision result here is "Yes", the unit **88** sets the acceleration-mode flag (step **S103**), and this routine is completed. A situation in which the acceleration-mode flag is set in this manner means that the feeding operation of the packaging material F is shifted from the halt state to the acceleration mode as apparent from FIG. **17**.

Thereafter, when the routine shown in FIG. **29** is repeatedly carried out, the decision result in step **S101** becomes "SET", and the unit **88** determines whether the second acceleration mode is suspended (step **S104**). If the decision result here becomes "Yes", the unit **88** resets the acceleration-mode flag (step **S105**). Therefore, the acceleration-mode flag is set at the time when the packaging material F is fed in the acceleration mode from the halt state, and the acceleration-mode flag is reset at the time when the acceleration mode is suspended. FIGS. **17** and **28** show the situation in which the acceleration-mode flag is changed over between "SET" and "RESET" in this manner.

On the other hand, If the decision result in step **S101** is "RESET" and the decision result in step **S102** is "No", the acceleration mode has not yet been started. In such a state, the unit **88** determines whether the above-described deceleration mode is temporarily suspended (step **S106**), discriminates the state of the filling flag (step **S107**), and determinates whether the first acceleration mode is suspended (step **S108**). If any of the decision results in steps **S106** to **S108** is "No" or "RESET", the unit **88** completes this routine.

However, if all of the decision results in steps **S106** to **S108** are "Yes" or "SET", the unit **88** sets the acceleration-mode flag (step **S109**). If the acceleration-mode flag is set in this manner, then the above-described reacceleration flag is set in step **S91** in FIG. **22**, and the feeding operation of the packaging material F is directly shifted from the temporary suspension state in the deceleration mode to the temporary suspension state in the acceleration mode. Thereafter, the acceleration-mode flag is maintained in "SET" state until the acceleration mode, i.e., the second acceleration mode for the packaging material F is completed, and then the decision result in step **S104** becomes "Yes".

Control Routine for Center Heat Sealer

When the above-described determination routine is completed, the unit **88** next executes a control routine **S3** shown in FIG. **30**. First, the unit **88** determines whether the feeding operation of the packaging material F is in the halt state (step **S141**). If the decision result here is "No", the feeding state of the packaging material F is any one of the steady speed feeding, the deceleration mode and the acceleration mode.

Next, the unit **88** determines the state of the acceleration-mode flag (step **S142**). If the decision result here is "SET", this means that the packaging material F is fed in the acceleration mode. When the feeding operation of the packaging material F is shifted to the acceleration mode through the steady speed feeding, the deceleration mode has already been carried out prior to the acceleration mode, and the center heat sealer **24** has been turned OFF in this deceleration mode as will be described later.

Thereafter, the unit **88** determines whether the feeding operation of the packaging material F is in the second acceleration mode (step **S143**), and determines whether the above-described start-timing signal is generated (step **S144**). Here, both the decision results in steps **S143** and **S144** are "Yes", this means that the start-timing signal has generated for the first time after the feeding operation of the packaging material F was shifted to the second acceleration mode, and at this time, the unit **88** changes over the operating state of the center heat sealer **24** from OFF to ON as shown in FIGS. **17** and **28** (step **S145**).

On the other hand, if the decision result in step **S142** is "RESET", the unit **88** determines whether the deceleration mode is temporarily suspended (step **S146**), and determines whether the stop-timing signal is generated (step **S147**). If both the decision results in steps **S146** and **S147** are "Yes", this means that the stop-timing signal has generated for the first time while the feeding operation of the packaging material F is kept to be in temporarily suspension state, and at this time, the unit **88** changes over the operating state of the center heat sealer **24** from ON to OFF as shown in FIGS. **17** and **28**.

In this embodiment, the center heat sealer **24** is turned OFF when the feeding operation of the packaging material F is in the deceleration mode, and more specifically, when the deceleration mode is temporarily discontinued. Further, the center heat sealer **24** is turned ON when the feeding operation of the packaging material F is in the acceleration mode, and more specifically, in the second acceleration mode.

When the operation of the center heat sealer **24** is changed over from ON to OFF, and from OFF to ON in the feeding state of the packaging material F shown in FIG. **17**, the heating intensity that the seam of the packaging material F receives in each of the modes is shown with hatch regions in (A) and (B) in FIG. **31**, and the total of the heating intensity is shown with hatch regions in (C) in FIG. **31**.

On the other hand, when the operation of the center heat sealer **24** is changed over from ON to OFF, and from OFF to ON in the feeding state of the packaging material F shown in FIG. **28**, the heating intensity that the seam of the packaging material F receives in each of the modes is shown with hatch regions in (A), (B), (C), (D) and (E) in FIG. **32**, and the total of the heating intensity is shown with hatch regions in (F) in FIG. **32**.

The two-dot line in (C) in FIG. **31** shows the total heating intensity when the center heat sealer **24** is turned OFF and ON simultaneously when the deceleration mode is completed or the acceleration mode is started. The two-dot line in (F) in FIG. **32** shows the total heating intensity when the center heat sealer **24** is maintained in its ON state during the deceleration mode and the acceleration mode. Therefore, even in the embodiments shown in FIGS. **17** and **28**, it is possible to apply just enough heating intensity to the seam of the packaging material F, and to maintain the quality of an outer appearance of the packaged product P.

The invention being thus described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the invention, and all such modification as would be obvious to one skilled in the art are intended to be including within the scope of the following claims.

What is claimed is:

1. A vertical sealing device for a vertical type forming, filling and closing machine for flexible packages, said machine including a filling tube which guides a cylindrically formed packaging material and which is used for intermittently filling at least one article into said packaging material, the packaging material being formed such that both side edges thereof are superposed on each other so as to form a seam extending along said filling tube, said machine comprising:

detecting means for detecting a non-filling operation of the article and a restart of the filling operation of the article after the non-filling operation is detected, respectively;

a feed unit for feeding the packaging material along said filling tube, said feed unit including a constant mode for feeding the packaging material at a steady speed during a normal operating state of said machine, a deceleration mode for decelerating the packaging material from the steady speed state when said non-filling operation is detected to a low speed state, and an acceleration mode for accelerating the packaging material from said low speed state thereof to the steady speed state when said restart of the filling operation is detected;

a center heat sealer for heating and sealing the seam of the packaging material, said center heat sealer being in contact with the seam and an open position where said center heat sealer is spaced from the seam; and

control means for controlling operation of each of said center heat sealer in response to the operation of said feed unit, said control means having a stop timing for moving said center heat sealer from the close position toward the open position when the operation of said feed unit is shifted from said constant mode to said deceleration mode, and a start timing for moving said center heat sealer from the open position toward the close position when the operation of said feed unit is shifted to said constant mode through said acceleration mode, and at least one of said stop timing and start timing being located within the corresponding one of said deceleration mode and acceleration mode; and

wherein each of said acceleration mode and deceleration mode has a temporary suspension region for suspending the deceleration or acceleration of the packaging material so as to maintain the packaging material at a speed, respectively.

2. The device according to claim **1**, wherein

said stop timing is located within said deceleration mode, and the start timing is located within the acceleration mode.

3. The device according to claim 1, wherein

said machine has one packing cycle time required for forming said package during the normal operating state of said machine, and a period of time of each of said acceleration mode and the deceleration mode substantially coincides with said one packing cycle.

4. The device according to claim 1, wherein

said machine has one packing cycle time required for forming said package during the normal operating state of said machine, and a period of time of said acceleration mode is set equal to or longer than said one packing cycle time, and a period of time of said deceleration mode is set equal to or shorter than said one packing cycle time.

5. The device according to claim 1, wherein

said feed unit feeds the packaging material at the same speed in said temporary suspension regions of said acceleration mode and deceleration mode.

6. The device according to claim 1, wherein

said control means has said stop timing determined within said temporary suspension region of said deceleration mode, and has said start timing determined after termination of said temporary suspension region of said acceleration mode.

7. The device according to claim 1, wherein

said feed unit continuously feeds the packaging material so as to directly shift from said temporary suspension region of said deceleration mode to said temporary suspension region of said acceleration mode when said restart of the filling operation of the article is detected immediately after the non-filling operation has been detected.

8. The device according to claim 7, wherein

said control means has said stop timing determined within the temporary suspension region of said deceleration mode, and has said start timing determined after termination of said temporary suspension region of said acceleration mode.

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